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SURGERY, GYNECOLOGY AND OBSTETRICS

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THE PHYSICIAN AND THE SURGEON[1]

BY HARVEY CUSHING, M.D., F.A.C.S., BOSTON

"WHY, in God's name, in our days is there such a great difference between the physician and the surgeon? The physicians have abandoned operative procedures to the laity, either, as some say, because they disdain to operate with their hands, or rather, as I think, because they do not know how to perform operations. Indeed, this abuse is so inveterate that the common people look upon it as impossible for the same person to understand both surgery and medicine. It should, however, be understood that no one can be a good physician who has no idea of surgical operations, and that a surgeon is nothing if ignorant of medicine. In a word, one must be familiar with both departments of Medicine."[2]

"*No one can be a good physician who has no idea of surgical operations, and a surgeon is nothing if ignorant of medicine.*" This, gentlemen of the College, is my chosen theme, and lest you think it a novelty of my own I hasten to add that the paragraph quoted is transcribed from writings which exist for us only in manuscript, since Lanfranchi, called the father of French surgery, who expressed this sentiment, lived two centuries before Gutenberg.

When one considers the healthy unification of Hippocratic medicine, why *was* there such a difference in Lanfranc's time, and must we admit that the difference he lamented still exists in ours? Does the shadow of the mediæval schism dividing medicine and surgery, and both from the church, which originated, history tells us, in a thirteenth-century papal decree forbidding the participation of the clergy in any procedure involving the shedding of blood—does the shadow of this schism still lie upon us? What difference, after all, is there between physician and surgeon except in the kind of cases each of them chooses to treat and in the variety of therapeutics applied? And in view of many centuries of separation, do we tend toward reunion or further separation? These are questions which concern in no small degree the very existence of this College.

THE PHYSICIAN'S PROGRESS

We certainly have stumbled along widely divergent therapeutic ways, we lay physicians and lay surgeons. The great physicians of ancient days were first of all given over to a polypharmacy inherited from the Arabians, then to the Law of Signatures with its astounding botanical therapeutics, then to a period of heroic bleedings and purgings and sweatings. Homeopathy followed, and taught the profession a much-needed lesson, and finally cellular pathology and bacteriology came to revolutionize physic by arousing a

[2] Cf. Henry E. Handerson's *Gilbertus Anglicus*. Privately printed. The Cleveland Medical Library Association, 1918, 77 pp.

[1] Presidential address before the American College of Surgeons. Boston, October 27, 1922.

profound skepticism in regard to the efficacy, whatever the dose, of most of the drugs abundantly prescribed for symptomatic purposes. This gave to the traditional practices a staggering blow, and the coal-tar products with synthetic chemistry finally closed the physic-garden, drove plants with a few notable exceptions from the pharmacopœa, and botany from the curriculum.

While all this was going on, much time was spent in evolving "systems" of therapeutics based upon bizarre interpretations of pathology which followed one another in succession, the Brunonian doctrine being one of the last, whereby diseases were either sthenic or asthenic; and a century and a half later we still hear "asthenic states" spoken of as ones which need supporting treatment by alcohol, so that even in these dry days the physician is privileged to prescribe the drug that was Brown's personal undoing, though he lived north of the Tweed.

It is an old saying that the wisest physician is he who knows the uselessness of the most medicines. Nevertheless, in an unfortunate alliance with the apothecaries, at about the time the surgeon was entangled with the barber, the eighteenth-century physician was accustomed to write prescriptions for patients he hadn't seen, while enjoying good company in the coffee-house. Some measure of common sense in matters therapeutic was finally knocked into the profession by the growing appreciation of the self-limitation of many diseases, by the success first of Hahnemannism, and, later, of other cults like Mother Eddy's which revived the therapeutic importance of a neglected principle well known in the Æsculapian temples—the influence of the mind upon body ailments, particularly when imaginary in large part, as so many of them are. Mr. Dooley once sagely remarked that "if the Christian Scientists had a little more science and the doctors more Christianity it wouldn't make much difference which you called in—provided you have a good nurse." And there is no doubt but that Florence Nightingale and her successors have also had much to do with modifying our modern therapeutics.

But the profession has not entirely regained its therapeutic sanity under these benign influences. Those uncritical and poorly-trained physicians who live in glass houses and give welcome to the prescriptions of certain pharmaceutical establishments which elbow their way to our desks on leaflets and postcards, cannot throw stones at the laity who give no less a welcome to nature-healers, herbalists, chiropractors, bone-setters, patent-mediciners, and other charlatans beyond enumeration. Little wonder that the wiser heads, both lay and professional, have about come to the conclusion that we had better limit the number of students in our schools, and let a smaller number, better trained, devote themselves to the prevention of disease and, through public-health measures, keep the bulk of the community well in spite of itself, in much the same way that we protect our live stock.

THE SURGEON'S PROGRESS

While all this has been going on through the centuries, in physic, the surgeon was pursuing an entirely different way, independent of tradition and for the most part, be it said, in rather bad company. A handicraftsman, often a rude, uncultivated, and ignorant though practical fellow of itinerant proclivities, he was rarely utilized in the schools, and when so employed, merely as the tool of the more learned and socially more respected physician. He had broken away from established authority: he ventured to write in the vernacular, and sometimes to operate without the physician's permission. Indeed, he did many unorthodox things. However, he was greatly needed especially in time of war, as Charles V used Vesalius; as four successive Bourbons used Paré; Elizabeth, William Clowes; Charles I, Richard Wiseman; and, to give an example from more modern times, as Napoleon used Larrey. Thus he came to be respected at court, even though he was kept out of the faculties where he was looked upon with scorn not untinged with jealousy. An outcast both of church and profession, he finally climbed into professional and some measure of social esteem about the middle of the eighteenth century by way of the barber-pole. But his long and quarrelsome alliance with the Guild of Barbers, humiliating enough,

was peaceful when compared with the quarrels of the physicians and apothecaries.[1]

A short century after the surgeons succeeded in breaking away from this alliance with "barbary" and were readmitted into the schools on the same footing as the physician, there came Lister on the heels of Pasteur, to revolutionize, not only surgical therapeutics, but at the same time, by the introduction of surgical cleanliness, the very hospitals in which both physic and surgery are practiced. And so it has come about that while the physician today has busied himself in perfecting elaborate methods of diagnosis for many chronic disorders, he rather shrugs his shoulders over therapeutics, whereas, on the other hand, treatment by operative methods has developed amazingly, and there is no gainsaying that in the hands of some it tends to run away with itself as a therapeutic measure.

REUNION OF PHYSICIAN AND SURGEON

Thus, in very rough outline, the two main clinical branches of Medicine, long separated both socially and professionally, have grown in ways so divergent that the fact of their origin from a common stem has become obscured by an accumulation of therapeutic débris left by a succession, on the one hand, of theorists who, like the modern endocrinologist, may perhaps see the patient as a whole but through a mist, and by the modern surgical specialist who sees only a part, but that part so disproportionately he is tempted to remove some of it.

Should these therapeutic groups be allowed to riot in their growth unmolested, branching in all directions at will, or will they bear better fruit if grafted or fertilized or cut back remorselessly? All agree that the time is at hand at least for some judicious pruning both in physic and surgery, and for the removal of sufficient rubbish to permit the main stem of Medicine and its roots of Science to be properly exposed and aerated. This process will be good for both root and branch, but more particularly will it benefit the branches if it has the effect of making the surgeon less of a pure technician and more of a physician, and the physician more capable of utilizing some of the minor procedures of surgery and with a better understanding of the major ones.

"*In a word, one must be familiar with both departments of Medicine,*" and this is no less true today than in the thirteenth century or in the days of Hippocrates. By no means did Lanfranc, in the statement which has been quoted, mean to imply that physicians must practice surgery—merely that they will be the better physicians, the better their understanding of surgical therapeutics; and, on the other hand, that no surgeon should be regarded as qualified to undertake operative procedures who is not primarily and thoroughly grounded in medical diagnosis. A graduate in medicine may have a very wide knowledge of surgery or even be a successful teacher of the subject without necessarily being himself an operator, just as one may have a thorough knowledge of music without being a performer. So, also, there may be many activities in which a physician may engage, beneficial to his profession, without necessarily "practicing" or prescribing drugs.

However, when in common parlance we differentiate physician and surgeon we do so only on the basis of therapeutics, and, granting the same underlying knowledge of disease, this is all that separates from medicine proper, homeopathy and osteopathy and all the other therapeutic cults, each of which reaches some degree of sanity so soon as it undertakes to perform surgical operations, as in time it is inevitable each one of them should do. There is nothing homeopathic about the scalpel, and when surgery was permitted to creep into this doctrinaire school it was near its end. The osteopath and chiropractor and eclectic and all the others may beware of this, for so soon as they come to engage in surgery, then a thorough medical grounding will be necessary,

[1] Sir William Stokes in his Cavendish Lecture entitled "The Altered Relations of Surgery to Medicine" (Tr. W. Lond. Med.-Chir. Soc., 1888, iii, 126–7), wrote as follows:

". . . In the interests not only of the social, but also the scientific position of the surgical profession, the junction, such as it was, of these two corporations [the Surgeons' and the Barbers' Company] was undoubtedly a calamity, and it helped to give the physicians the vantage-ground which they occupied so long, and in which they were still further strengthened by an enactment made in Elizabeth's reign, prohibiting surgeons from prescribing internal medicines. As a proof that the inferior position, socially and scientifically, was maintained up to a comparatively recent period, I may mention as a fact which I learned from Mr. Colles, who informed me that his father, Abraham Colles, had stated that at the commencement of his professional career in Dublin, when a consultation on any important case was held, the surgeon was not as a rule permitted to be in the room where the physicians held their deliberations, but, after the consultation was over, he was informed whether his services would be required or not."

so that the natural end of all such cults is, that, dead or alive, they will become swallowed in time by the general profession, distasteful as the dose may be.

METHODS OF TEACHING

Unquestionably, what chiefly influences the direction of its growth is the way in which Medicine as a whole is taught—the way in which its various subdivisions are presented to the student, and the relative stress laid upon them. Whatever their spirit of altruism, most of our students enter the profession as a means of livelihood, and are likely to be influenced by what seems to them, given an ordinary degree of ability, to be the most likely road to an income-producing end, whether it be as a laboratory worker, or public-health official, or physician, or surgeon, or specialist of any sort. A disproportionate amount of teaching, or better and more personal teaching in one subject over another, whereby the student's interest is aroused and he begins to feel a certain amount of confidence in his knowledge, will inevitably lure in that direction the larger number.

The periodical turnover in our curricula is an evidence of the fact that faculties show a perennial dissatisfaction with existing conditions, and strive each of them to find the proper average allocation of subjects; little realizing that it makes no great difference—that the fault lies with us the teachers, not with the curriculum, for Medicine can be successfully taught from many angles if only students are properly stimulated and encouraged to observe and think and do for themselves. But what has become particularly apparent of late, is that the curricular tree has become overloaded by grafting upon the clinical branches an undue profusion of specialties, few of them of fundamental importance even though they doubtless bear fruit of marketable value which dangles before the student's eyes so alluringly that he is prone to forget, or to overlook entirely, the source of origin of the specialty in general Medicine.

There has been a great reaction against this, and our supposedly more progressive schools are engaged in lopping off a number of these clinical branches. Some schools, indeed, have come to pay so much attention to the root and stem that if we do not beware, the top will be cut back so far that there will be neither foliage nor fruit—no medical practice whatsoever—and thereby encouragement will be given to the growth of every conceivable form of quackery which will spring up around us as have the schools of the chiropractor, to fill the depleted ranks of the profession; and the indifferent public is probably worse off than it was before.

Reforms are often necessary, but there are no schools for reformers. They, like the physicians of the Middle Ages, are inclined to administer such drastic treatment that the object of the reform, whatever it may be, relieved of the existing ailment, is left subject to other and more serious ills. Much needed as he is, the reformer rarely advocates homeopathic doses or gives a chance for the malady he would correct to be overcome by natural processes. So far as our diminishing supply of family doctors is concerned, there are many who have come to feel that it would be better for us to send out after two years of clinical study alone, with some additional knowledge of public health, a group of men to be licensed as Bachelors of Medicine. They at least could attend to the ordinary ailments and health of the rural districts, where public opinion is largely made and from which legislation, detrimental or otherwise to the interests of the profession in its campaign for sanitary measures, is likely to emanate.

TEACHING WITHOUT THE PATIENT

It is a curious commentary on our methods, that while we have come to emphasize the importance of teaching the preclinical sciences by practical laboratory exercises so that the student may at least have some first-hand knowledge of the scientific method and may learn to interpret and observe for himself, we have tended, if not to abandon, at least to postpone, to the end of the course, these very methods so far as the clinic is concerned. To be sure, we have long outgrown the time-honored quiz as the basis of teaching, than which nothing could have been less practical. A student may know his textbook thoroughly, may, for example, give without hesitation,

when asked for them in an examination, all the symptoms of that vanishing disease typhoid fever, but if he has to utilize his own observation, senses, and wits, and dig out, himself, the essential symptoms and signs which make the diagnosis possible, he is so incapable of reversing his acquired mental processes that the idea of typhoid fever never enters his bewildered head. Only by prolonged contact with the patient at the bedside can he come to take a good history, to make a proper examination, to learn to separate the wheat from the chaff of the patient's complaints; all of which must precede the interpretation and the treatment of the existing disorder.

The so-called case system of teaching has become highly developed and popularized in certain schools—a diagnostic exercise whereby through the process of elimination and logic the predigested data acquired by a variety of people is presented for discussion and analysis. Such a method is excellent for training in the law, since in the legal profession one argues on the basis of authority and accumulated testimony, in accordance with which satisfactory judgments can be rendered and punishments meted out without even seeing the culprit. But the medical profession has long since broken away from dogma and authority, and though the case system, handled by a lively instructor, provides an interesting exercise in medical diagnosis far superior to the old-time quiz, when carried far, it has the great danger of making logicians of the students, rather than practical physicians. There is some danger lest the student be led to feel that it is unnecessary, for a diagnosis, to examine the patient oneself—someone may get the history, another make a physical examination, still others supply the X-ray findings, the laboratory tests, and so on, while all that the modern physician needs to do is to sit and expound, as did the mediæval anatomist while the barber did his dissections for him. Excellent as they may be, there is nothing practical about such exercises, and if overemphasized they are bad for both teacher and student—for the teacher because he gets out of the habit of making his own thorough examination of the patient; for the student, who gets an impression that the diagnosis, which an autopsy may confirm or otherwise, is the only thing of importance, and treatment for the most part futile. Meanwhile the patients in their homes, in the dispensary, even those in the wards, would like to know what these professors who admittedly are having difficulty in telling without looking at the organs, what certain people died from, are going to do to relieve their individual backaches or troublesome coughs—and perhaps it would be just as well to go to a chiropractor next time. Indeed, it takes a good deal of explaining to make clear that a lumbar puncture, bismuth studies under the fluoroscope, a blood urea examination, metabolism observations, Wassermann tests, and electrocardiograms made by as many different people, most of them technicians at that, each in their several laboratories—that all these things are necessary preliminaries to the recognition of his malady. All too often, alas, the knowledge thereby gained fails in any way to make him more comfortable, or to prolong his expectation of life. The patient submits to all this and is very glad to know, in the abstract, that diagnosis has become a laboratory science which employs the modern principle of piecework, and that the medical profession looks forward to the prevention of many existent diseases from which posterity will be exempt —but "meanwhile, doctor, what can you do to relieve my present discomforts so I may get back to work?" He is inclined like the Irishman to ask, "What has posterity ever done for me?"

THE HOME-TRAINING IN MEDICINE

The curriculum in all of our schools still retains one essentially practical clinical course to which attention may be drawn—a course forced upon us by boards of registration, else even this might be curtailed or lost. It exists in the case of obstetrics, for no student is allowed to get his degree unless he has actually, himself, supervised a certain number of confinements. Here is an actual test of the medical novitiate's resources, the one practical test of what he may be able to do in a possible emergency in a patient's home. Nor would any of us wish to see the students robbed of

this invaluable experience. On the contrary, it would be an admirable thing if the principle could be extended and every student, before his graduation, required, under the control and supervision of his teachers or the district physician of the community, to engage in an actual house-to-house practice, armed perhaps with nothing more than a clinical thermometer, a stethoscope, his fingers, and wits, supplemented perhaps by a microscope and a few aniline dyes. In this way he might learn something at least of the living conditions which modify the health of the people he now only meets in the dispensary, surrounded by all of the paraphernalia and instruments of precision supposed to be necessary for a diagnosis. It is a leaf one might take from the book of certain of the training-schools for nurses whose candidates must prove their capacity to engage in actual home-practice before they can qualify for a degree. One of our highly trained young physicians, long-time resident in a teaching hospital, recently confessed to me that he had just been through one of the most valuable experiences of his ten years of medical study. He had passed his summer on an island where was a large summer community, and in the absence of any local physician he had volunteered to hold office hours and prescribe for the needs of his fellow-sojourners, his principal armament being a thermometer, his microscope, some bandages, and a few simple drugs. Never before had his powers of observation and his common sense been so thoroughly exercised.

THE SURGEON IN OTHER COUNTRIES

It is a curious anomaly that the British surgeon taken as a whole is probably in practical ways a better trained physician than is the American surgeon, and yet he rarely possesses a full medical degree and is apt to pride himself on not being called a doctor. Here, on the contrary, the surgeon though graduated a Doctor of Medicine, not infrequently lapses into the state of being little more than a craftsman who, except for the external parts of the body, makes little or no pretense at diagnosis but expects the "internist," often without any expression of an independent judgment, to show him the way.

Different countries—indeed, different parts of the same country—vary greatly in the attitude of physician or surgeon toward their problems. This past summer, during an all-too-short service as *locum tenens* for Mr. George Gask at St. Bartholomew's Hospital, I have had a most illuminating experience which has left me with the impression that the British student gets a more practical clinical course, based upon far better training in anatomy and gross pathology than do most of our students, and that he is far less inclined to lean upon laboratory accessories in making his diagnosis. He, for a longer time and more intimately, is brought in contact with the 90 per cent of human ailments upon which complicated laboratory tests have no special bearing, and through practical experience is apt to arrive at a reasonably sound conclusion in regard to his patient's disorder and have a shrewd idea of the appropriate form of treatment. True, he may miss some of the more rare conditions, for which, after all, little can be done therapeutically—conditions which our students, with their vastly better laboratory facilities, might recognize in all likelihood. But, should we put side by side at work in a small town the average product of these two methods of teaching, I am inclined to think that the former would be the more resourceful, and exercise greater wisdom though possessed perhaps of less learning. And, after all, the strength of a profession, as of a nation, is represented by its average product.

CARE OF THE MINOR AILMENTS

One looks in vain in the curriculum for a course on the common sense treatment of minor ailments. It has been said by a wise and philosophical lay observer of the profession that so far as he can see, the only difference between the so-called "practical" doctor and the "scientific" one who has had a thorough laboratory training, is that the latter is more likely to cure his patients. But with all personal sympathy for this point of view, the community, particularly its rural portion, still has an enormous need for the common sense practitioner, who for his four undergraduate years, under careful super-

vision, has seen less of complicated laboratory methods and more of the handling of sick people afflicted with the common everyday minor injuries and maladies. Otherwise we shall utterly abandon this all-important work to quacks and charlatans, who may become very skillful at it, in spite of their chicanery. I am not at all sure but that, for most of our schools, some measure at least of the French system would be best, whereby from the very outset of their course medical students are brought in direct contact with patients, and the laboratory courses are given conjointly and possibly prolonged throughout the four years.

We must somewhere and somehow strike a middle ground between over-training in the laboratory and under-training at the bedside, or the reverse. Certainly at the present time our graduates—many of them at least—no longer feel that the rôle of the country doctor, or even the general practitioner in the town or city, is at all an alluring one, even a possible one, so dependent have they become on complicated laboratory findings in arriving at a diagnosis. Unquestionably, there is an economic element which also enters into this, for a training in Medicine at the present day is unduly long and expensive, entirely disproportionate to any possible returns to be gained from a rural practice.

STRESS UPON BIOLOGY RATHER THAN ANATOMY AND PATHOLOGY

The present stress laid in this country upon the preclinical laboratory courses, particularly those in chemistry and physiology, has without doubt greatly influenced the entire point of view of the physician, who must have a calorimeter and an electrocardiograph with a technician to operate them, if only to keep in fashion, little realizing that they are scarcely more than research instruments. There has been much talk about the modern physiological schools of physic and surgery, and I presume this means that it is less fashionable for the clinicians to grub in the pathological and anatomical laboratories than formerly. Anatomy and pathology just now appear to the unimaginative to have been thoroughly explored; the pioneers have taken the surface washings, and rather than dig deep for gold we prefer to look elsewhere for novelties and chance findings.

The interest of the students in these two particularly essential subjects has unquestionably flagged, for they naturally reflect the attitude of their teachers. There is no better illustration of this than the fact observed in many hospitals, that the physician is less apt than formerly to follow his patients to the operating room, and appears to be less eager than in days gone by to have a view, during life, of the pathological lesion. His place there has been taken by the radiographer who is more often on hand to see his diagnoses confirmed or otherwise. This may be for the reason that the disclosures at the operating table relate to regional pathology, and the surgeon rarely exposes lesions which will enlighten those interested in blood urea, the Wassermann reaction, calorimetric or electrocardiographic estimations.

THE PHYSICIAN-SURGEON

Does this not mean that the surgeon has become the internist, or, put another way, that the internist (as the physician was once called) has come to do his own surgery? If this be so, it behooves the surgeon to accept the fact that he must be, primarily, a good physician,—and the physician, loth as he may be to admit it, that he has undergone a metamorphosis. A year ago this College gave an honorary fellowship to the professor of medicine of the University of Stockholm, who had evolved an operative method, entailing great skill, whereby the adherent lung may be completely collapsed in the treatment of pulmonary tuberculosis. A distinguished member of this College, whose name we perpetuate by an annual oration, first conceived the idea of putting the diseased lung to rest, but it remained for Professor Jacobaeus, a physician, to add a further and important step to the procedure by the intrathoracic division of pleural adhesions—a step which had not been undertaken even by so imaginative and radical a surgeon as was John B. Murphy.

This, indeed, was a very significant and unusual occurrence, but, properly interpreted, the giving of this fellowship was merely an

admission of the successful invasion of the surgical field by one who occupies a chair of medicine and the prompt recognition of his contribution by the surgeons. Similar therapeutic invasions of what was once "internal medicine" have been made by those who because they handle a scalpel and are willing to set broken bones are called surgeons, with no corresponding recognition, so far as I am aware, by societies of physicians.

There are, however, certain exceptions in the case both of individuals and of special societies,—men who without disrespect are called surgeon-generals of army, navy, or marine corps, are apt to hold membership in societies both of physicians and surgeons, even though, like the lamented Gorgas, they may be essentially sanitarians,—societies, too, which recognize the inadvisability of confining their numbers to those averse or otherwise to a participation in surgery. The neurologists, for example, have opened their membership to so-called neuro-surgeons, to the unquestioned benefit of those who do, and those who do not, care personally to employ operative methods of treatment. It has made the surgeons strive to be better neurologists, and given the neurologists a better conception of what therapeutic contributions their surgical colleagues are capable of making. It enables both groups better to keep their feet on solid ground and there is no danger that the society will ever become so overrun by the surgeon as to let operative therapy fly away with itself and jump over the moon.

TENDENCIES IN PHYSIC AND SURGERY

May I indicate the direction of our present drift, as physicians and as surgeons, by citing two recent examples from my own clinic—they are extreme examples, I admit, but they will serve my purposes. Patient Number One was referred for diagnosis from a sanitarium which she had entered because of headaches, and where she had had a long and expensive sojourn. She brought with her a sheaf of records detailing special studies, made by different people, on her blood (even to the coagulation time), cerebrospinal fluid, stools, fields of vision, metabolism, alveolar air, and carbohydrate tolerance. It was an impressive array of findings, all within the normal limits of error. The X-ray, however, had shown a "closed-in sella," and after a period of pituitary gland administration without benefit, she was finally advised to undergo an operation and sent here for that purpose. So far as we could determine, she was an overconscientious and overworked medical librarian greatly in need of a long-postponed vacation, who incidentally had been reading at odd hours a popular book on the ductless glands.

In contrast to this, let us turn to the surgeon-specialist and his outstanding fault, in that he often fails to see the patient whole. At the moment of this writing, Patient Number Two has entered the hospital—a poor fellow who for several years has been having frequent uncinate seizures, associated with a vivid olfactory impression. Meanwhile, he has had nine intranasal operations in separate sessions—a septal resection, ethmoids, sphenoid, and both antra opened and drained, turbinates removed, and finally all his teeth extracted. Of course we smell with our noses; the patient complained bitterly of a disagreeable odor, *ergo* nasal operations. What could be more simple? That he had during all this time an homonymous hemianopsia was not observed. It is a venturesome and expensive thing to consult a surgical specialist who does not see beyond his own—or his patient's nose. And this represents for all of us the great danger of surgical specialization, when carried to an extreme, whether it be in rhinology, gynecology, neurology, or what you will. And when the specialty removes itself from contact with general medicine and retires to an isolated hospital given over to a single class of cases it is a danger still more difficult to avoid. Indeed, a ward in a general hospital, so given over, may become no less a place of isolation with its inevitable narrowing tendencies.

A wise physician and teacher, in discussing internal medicine as a vocation, once said that "the manifestations of almost any one of the important diseases in the course of a few years will box the compass of the specialties." It is no less—perhaps even more—true of surgery, and for this reason I believe it to be fundamentally essential in a general hos-

pital, however inconvenient for the attendants, that conditions represented by the specialties shall be scattered in the wards among the patients still grouped under general surgery, so that staff, house officers, nurses, and students alike shall at least continue to have some due sense of proportion regarding general surgery and surgical specialization, and the relation of both of them to Medicine.[1]

THE RÔLE OF THE COLLEGE

This College of Surgeons in its short life has assumed some very responsible functions. It is playing a not unimportant rôle in international affairs by bringing together through the common bonds of professional interest the surgeons of this western hemisphere—of Canada, Mexico, and South America as well as of the United States. We have much to learn from each other. Another most important task it has undertaken is to improve, and in a measure to standardize the work done in our larger hospitals. The modern "Survey" with public ventilation of its findings is one of our most advantageous methods of bringing about reforms. So our hospitals, some seven hundred in number, which have over one hundred beds each, have been classified with the result that improved methods of organization have been adopted which have enormously safeguarded the patient—particularly the patient destined to undergo the hazards and aftermath of an operation. It has been an expensive and laborious task, this survey, but a task well worth while, and it is now to be extended so as to include the smaller community hospitals of over fifty-bed capacity, which are far and away more numerous.[2]

The College, too, has from the outset taken a vigorous stand against that abomination which prevails, it is said, in some parts of the country to such an extent that public confidence in the profession has been seriously shaken. It is a matter which bears some relation to these very trends of physic and surgery which I have endeavored to make clear earlier in this address—the surgeon becoming a pure operative technician, incapable of making a diagnosis—the physician, impoverished in therapeutic resources and with so poor a conception of surgery that he will let out his patient to the lowest bidder willing to operate at his dictation, and divide the purse.[3] This takes us back to the abuses of the Middle Ages. It is an abuse which could not possibly exist in any community if the surgeon was trained to make his own diagnosis and if the physician would refuse to employ a surgeon incapable of arriving at an independent opinion regarding the necessity or advisability of an operation. For such a surgeon is apt to be equally neglectful of what is often the most important part of every surgical procedure—the after-treatment. The physician who lends himself to such a practice is in the position of one who prescribes a dangerous drug to his patient without knowledge of its dosage or action, for there is no drug in the pharmacopœa so dangerous as misapplied surgery.

It seems to me that it would not be a bad idea if in our tests of eligibility for fellowship in this College—tests which not only are those of moral and professional character but of operative experience and skill—we should demand something more than the mere report upon a fixed number of major operations successfully performed, but should require, as well, information as to whether the diagnosis of these cases were the result of the candidate's own personal observation, or whether they were made for him by another.

We have seen that the present trends affecting the physician and surgeon are, on the one hand, toward preventive medicine and good nursing which lessen the importance of drugs in therapeutics; on the other, in surgery, an ever-increasing subdivision and specialization which tend to magnify the importance of mere handicraft. Prevention, it is true, can also be applied in surgery. Many industrial accidents can be prevented: the rule of safety first can be followed; there would be no more gunshot wounds if fire-arms and war were abolished; if we can finally stamp out tuber-

[1] I do not know whether a proposal that my medical colleague and I exchange places for a few weeks each year will ever be acted upon, but we at least hold a conjoint visit of the medical and surgical staffs once a week, and thereby endeavor to see *Medicine* whole, and to encourage our students to do so.

[2] It may be noted that 75 per cent of the one-hundred bed hospitals had adopted by 1921 at least the minimum standards of acceptability, whereas in 1918 only 13 per cent of the 692 hospitals surveyed had been accepted.

[3] It is significant of the success of some of the activities the College has engaged in, that laws against fee-splitting have been adopted by man State legislatures.

culosis and eliminate cancer there will be far less for the surgeon to do. If women did not have children, if people did not drink, if we could only keep the policeman off his feet, the housemaid off her knees, the miner off his elbows, the aviator out of the air, the boys away from football; if all children in goitrous districts were given a little iodine, there would be less need for the surgeon. But we do not yet live in the Isle of Utopia, and however much the need of the physician may be lessened through the agency of preventive medicine, by eliminating disease as typhoid has been largely eliminated, and yellow fever, and as malaria can and will be, and many nutritional disorders and perhaps goiter, the surgeon will continue to be needed and I cannot see but that he must become a better and better physician.

When physicians acquire a more intimate knowledge of surgery, fewer people in need of operative procedures will be turned over to the surgeon too late, after delays caused by an inordinate number of unnecessary laboratory procedures. When surgeons are required to have a thorough grounding in general medicine before practicing their handicraft, fewer unnecessary operations will be done and many of the evils which exist in their professional relationship with physicians will be eliminated.

All of which has been said as well and much more briefly by Lanfranc: "No one can be a good physician who has no idea of surgical operations, and a surgeon is nothing if ignorant of medicine. In a word, one must be familiar with both departments of Medicine."

THE ANATOMY AND IDENTITY OF "ENCYSTED" AND "INFANTILE" HERNIA

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MY first recollection of the terms "encysted" and "infantile" hernia dates back to my student days, and more particularly to that well-known chapter on hernia in Gray's *Anatomy*, in which the author illustrates a common scrotal hernia. He proceeds to illustrate four abnormalities of inguinal hernia, namely, congenital hernia, hernia into the funicular process, infantile hernia, and encysted hernia. I studied these illustrations with requisite care, and in due time flattered myself that I had mastered their intricacies. Skepticism as to the correctness of these illustrations was aroused by the fact, that in four of these illustrations, namely, the ordinary scrotal, the congenital, the encysted, and in the hernia into the funicular process, the testis was located posterior to the hernial sac, and that only in the sole remaining one, namely in the infantile hernia, was the testis located in front of the hernial sac.

In the course of time, and more particularly after I had the opportunity to study cases by personal observation, my views began to crystallize themselves. However, when I began to compare the knowledge thus gained upon the operating table with a study of textbooks on embryology and surgery, I was again confused. Finally I arrived at the following conclusions:

1. That the nomenclature of the subject is archaic.

2. That the older observers, such as Hey, who first coined the word "infantile" hernia, and Sir Astley Cooper, who first coined the word "encysted" hernia, while they may have been clear in their conception of the cases, were certainly not clear in their description.

3. That the indefinite statements of these early authors have been perpetuated by subsequent writers; and, as I believe, mostly from a fear of exposing their ignorance.

In a chapter on hernia written for Johnson's *Surgical Therapeusis* in 1915, I made the following statement:

"The term 'infantile' hernia is another misnomer. Some authors describe a hernia in which the maldevelopment is practically identical with that of an 'encysted' hernia; but the hernial protrusion, instead of becoming invaginated into the preformed lower sac, descends behind it; to this form they have applied the vague term 'infantile' hernia. I see no necessity for this subdivision; there is no material difference between the two forms of hernia."

I had intended to convey that there is no difference between encysted and infantile hernia. A recent incident has led me to believe that there is still confusion in regard to this matter, and it is my present purpose to clarify the subject as far as I am able to do.

For a more ready understanding of this abnormality of the hernial sac, it will perhaps be preferable to subject to a review all of the abnormalities of the hernial sac, as they can all be reduced to a fault in the closure of the processus vaginalis. As is well known the testis in its descent into the scrotum is always accompanied by, or, according to some authors, even preceded by an outgrowth of peritoneum, that has received the name processus vaginalis peritonei. After the descent of the testis has become complete certain retrograde changes occur in this vaginal process; it becomes shut off above at the upper or abdominal end, and below just above the testis; while the intervening portion becomes obliterated, and remains as a fine cordlike structure within the confines of the spermatic cord. The distal portion persists, and becomes the tunica vaginalis testis. The drawing as shown in Figure 1 would therefore represent this condition.

The great frequency of oblique inguinal hernia has led some observers, notably Murray, to the belief, that many (if not all) of these herniæ are due to an imperfect closure of the vaginal process at the upper end, and are therefore of a congenital nature. Tempting as

this theory is, it falls by the fact, that compared to the number of unafflicted individuals the sum total of persons afflicted with a hernia is after all very small. The majority of surgeons, therefore, assumes that if the involution process is normal, the closure at the lower end occurs just above the testis, while at the upper end it occurs opposite the internal inguinal ring, so that when complete the peritoneum is flush with the abdominal parietes, without any discoverable dimpling.

If a scrotal hernia forms in such a normal case, it follows the direction of the cord, and lies in front of it. It can be illustrated diagrammatically as is seen in Figure 2.

The obliteration of the processus vaginalis as outlined above in brief, is subject to various maldevelopments.

1. CONGENITAL INGUINAL HERNIA

Let us assume the following condition. The testis has descended fully into the bottom of the scrotum, accompanied by the normal processus vaginalis, but at this stage the course of normal development has stopped, i.e. the processus vaginalis has failed to become shut off at both the testicular and abdominal ends, nor has the intervening portion become obliterated (Fig. 3).

It is evident that we are dealing in this case with a complete hernial sac, which communicates above with the general peritoneal cavity. All that is necessary is some unusual effort to force intra-abdominal contents into the hernial sac, in order to form a complete scrotal hernia.

This is the hernia which has received the time honored name "congenital inguinal hernia." That this name is erroneous is self-evident for many reasons. First, because the sac alone is congenital; hernial contents may find their way into the sac before, during, or shortly after birth. On the other hand they may not find their way into the sac until late in life, or never; it is only in this manner that we can account for those cases, which come only late in life, though very soon after the occurrence of a hernial protrusion to operation, at which the presence of the congenital malformation, as above described, is recognized.

Another and perhaps more important reason why the name of "congenital inguinal hernia" is a misnomer, is, that it pre-empts the word "congenital" for this one particular subvariety of congenital hernia, whereas there are a number of other herniæ, which are also congenital, inasmuch as they depend on an antenatal formation.

If the task were assigned to me to rewrite the nomenclature of these malformations, I would have no hesitancy to call this particular subvariety a "hernia into the vaginal process." This name would describe the hernia fully and properly in all detail. Regrettably this name has been erroneously preempted by another subvariety, as will be seen later. The truth, however, remains unequivocal, namely, that this is the only true "hernia into the vaginal process."

The sac of this hernia has certain well-marked characteristics, which differentiate it from an acquired hernia. These are that the sac is very apt to be exceedingly thin, so that its isolation in the course of operation is apt to be much more difficult. Not infrequently there are to be seen ridges and elevations within the lumen of the sac, which are very probably abortive attempts on the part of nature to effect a closure and obliteration.

The principal characteristic of this hernia which stamps it in a class by itself, and which is not present in any other hernia, is, that the testis is within the hernial sac.

2. HERNIA INTO THE FUNICULAR PROCESS

As was just seen, in the "congenital inguinal hernia" so called, the vaginal process of the peritoneum which accompanies the testis in its descent into the scrotum, has become shut off neither at its testicular nor at its abdominal end, nor has the intervening portion become obliterated. Let us now assume a condition in which the vaginal process has become shut off only at its testicular end, and the part in juxtaposition to the testis forms the tunica vaginalis testis; on the other hand, the abdominal end has remained patent, and the intervening portion has not become obliterated. If now intra-abdominal contents find their way into the unobliterated portion of the sac, we have before us a hernia, which, and incidentally also erroneously, has received the

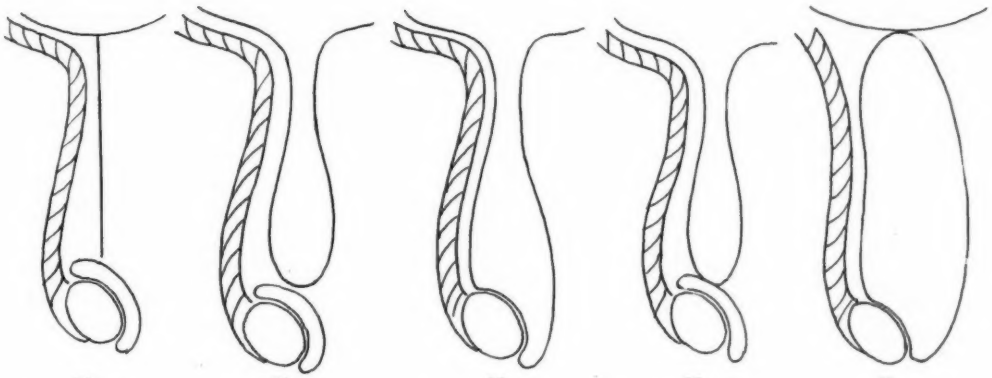

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

Fig. 1. Diagrammatic illustration of a normally descended testis, showing the shut-off peritoneum, normal tunica vaginalis and cord remaining after the obliteration of the processus vaginalis.

Fig. 2. An ordinary scrotal hernia.

Fig. 3. Congenital hernia.

Fig. 4. Hernia into the funicular process.

Fig. 5. The condition as it exists prior to the formation of an encysted hernia.

name of a "hernia into the funicular process" (Fig. 4).

If this hernia is now compared to an ordinary acquired scrotal hernia (Fig. 2), there is evidently such a striking similarity between the two that it becomes a matter of more than ordinary difficulty to discern any great difference between the two. In fact, the difference is so slight that I have arrived at the conclusion that many cases are overlooked and unrecognized and are classified under the heading of ordinary acquired scrotal hernia.

The differences are the following: (1) Owing to the congenital nature the sac is apt to be exceedingly thin and friable, and on that account extirpated with difficulty. (2) The slender cord which remains behind after the obliteration of the processus vaginalis is absent.

It may now be asked, how can a surgeon recognize a hernia of this nature upon the operating table. A little reflection as to the mode of origin of the sac of this hernia will immediately render it clear, that even though the sac and the tunica vaginalis are two separate cavities, the serosa which makes up these cavities is really one; in other words one cannot be separated from the other without opening into both. I have seen cases of this nature operated upon, and the surgeon ascribed the accidental opening of the tunica to his clumsiness; as the accident is of no consequence no further attention was paid to it, and the case is put down as an ordinary scrotal hernia.

Anatomically speaking the name which is ordinarily given to this hernia, namely, "hernia into the funicular process" is a misnomer. In a strict sense of the word, the hernia vulgo known as the congenital hernia is the only true hernia into the funicular process. I do not know that I can give an accurate name, and one which would be sufficiently descriptive; possibly "hernia into the supratunical vaginal process" may do.

3. ENCYSTED HERNIA

Let us now assume that instead of the distal end, as in the condition just discussed, the proximal end of the processus vaginalis has become shut off, and we will have a condition which can be illustrated diagrammatically as in Figure 5.

The descent of the testis is one of the oldest embryological processes, and has been studied by so many observers, that one would think that all of its stages are well known, and definitely settled. Surprising as it may be, this is far from true. The literature contains many diverging views.

Oscar Frankl (1) studied the subject with great care and analyzed the literature up to his time, and also added the experiences

gained by his own observations and found the following: Camper (2) states that the obliteration of the processus vaginalis begins at the upper pole of the testis, and that it proceeds in an upward direction, up to the internal inguinal ring; Jarjaway (3) states that the obliteration begins at the middle and proceeds in both directions; Fere, that it begins in the region of the external inguinal ring and proceeds both upward and downward; Kocher (4) is inclined to believe that the obliteration begins at the internal ring, and that its progress is in a downward direction; Sachs (5) seems to agree in the main with the views as expressed by Jarjaway. Frankl himself is inclined to accept the theory of Sachs, but in view of the fact, that he has found, that if there exists a complete obliteration at the middle of the processus vaginalis, there is usually also one at the internal inguinal ring, he believes that the obliteration really begins at two places, namely, both in the middle and at the internal ring.

Personally I believe that there is no rule, and that at best we can speak only of a most frequently found method. I base this opinion upon the previously proven facts: (1) that numerous examples exist, at which only the upper end, or only the lower end of the vaginal process has been found shut off; (2) that upon quite a number of occasions I have been able to demonstrate in the sacs of so-called congenital hernia a very definite ring approximately at their middle, somewhat as is illustrated in Figure 6. In fact I have seen three cases in which this raised ring was the cause and seat of a pronounced strangulation. It is even quite possible that the closure can begin at several points; this to my mind is definitely proven by the findings of several so-called hydroceles of the cord in the same individual, and also by the finding of the so-called rosary hernial sacs, which to my mind are only a less advanced stage of the former. As is seen there is a great deal that is merely suggestive about the closure of the vaginal process. One thing is certain, namely, that cases have been recorded in which the vaginal process is shut off only at its upper end and not at its lower, nor has the intervening portion dwindled. I do not know that the condition has ever been dissected and described. On theoretical grounds it is somewhat as I have illustrated it in Figure 5.

Now let us suppose that a hernia forms in a case with this maldevelopment of the processus vaginalis. Try hard as I may I cannot see but that the hernia must come down in front of the cord and vaginal process, and never behind these structures, nor between the two. In other words the hernia can be graphically represented as in Figure 7. It is but proper to mention that as far as I know this condition has never been described, though of course there is no reason whatsoever why it should not exist. The condition, of course, presumes an empty vaginal process or one practically so.

This condition, however, changes at once, if the sac is filled with an exudate, particularly if the exudate is not too excessive. Prior to the existence of a hernia a sort of a congenital hydrocele forms, which is but very little different from a good sized ordinary hydrocele (Fig. 8).

If a hernia now forms a portion of the peritoneum lining the general peritoneal cavity protrudes into the completely shut off serosal sac. It is this hernia which has received the somewhat ambiguous name of "encysted" hernia (Fig. 9).

In operating upon such a case one is surprised, on incising the sac, to find at first no hernial contents; indeed not even a communication with the general peritoneal cavity is found. If this sac is now extirpated (a somewhat difficult procedure at its superior pole), or if the posterior wall is incised, the true sac of the hernia is found bulging into the first sac. If critically examined this hernia resembles in every respect an ordinary acquired inguinal hernia, which happens to be associated with a good sized hydrocele. There is however this one important difference, namely, that the fundus of the hernial sac is densely adherent to the upper part of the hydrocele; as a matter of fact, being one, they cannot be separated from each other.

This is an exceedingly rare variety of hernia, but I have no hesitancy in stating that many cases are overlooked; a not at all surprising matter, when one considers, that, surgically speaking, all the difference between

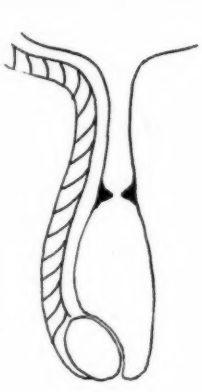

Fig. 6

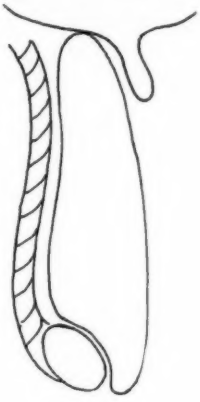

Fig. 7

Fig. 6. Processus vaginalis with congenital ring formation.

Fig. 7. Hernia in front of an encysted hydrocele.

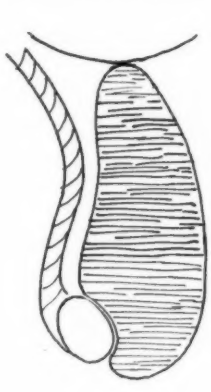

Fig. 8

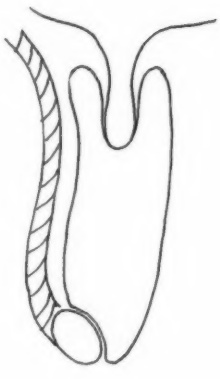

Fig. 9

Fig. 8. Encysted hydrocele.

Fig. 9. Encysted hernia.

this rare form and the somewhat more frequent ordinary inguinal hernia, complicated by an ordinary hydrocele of the tunica vaginalis testis, hinges upon the ease or difficulty of separating the two structures. I have personally encountered several cases of the hernia under discussion. I take no especial credit for making the diagnosis, because I am always on the lookout for this possibility whenever I operate upon a large hydrocele, with or without a manifest hernia. It is not impossible that I am in error, for as already stated the criteria upon which I base my diagnosis are only two, viz., an invagination of the hernial sac into a hydrocele sac, and the impossibility to separate the two from each other. I have no hesitancy in stating that this is the hernia which Sir Astley Cooper described under the name of "encysted hernia." One or two of his sentences are not quite clear and lack his usual perfect descriptive style. Cooper (6) writes:

"On opening the tunica vaginalis[1] instead of the intestine being found lying in contact with the testicle, a second bag or sac is seen inclosed in the tunica vaginalis, and enveloping the intestine. This bag is attached to the orifice of the tunica vaginalis, and descends from thence into its cavity.[2] It generally contracts a few adhesions to the tunica vaginalis, while its interior bears the character of a common hernial sac.

"The idea which I have formed of the nature of this variety of hernia is, that the tunica vaginalis, after the descent of the testis, becomes closed opposite the abdominal ring,[3] but remains open above and below. The intestine descends into the upper part, and elongates both the adhesion and tunica vaginalis, so as to form it into the bag, which descending into the tunica vaginalis below the adhesion, and becoming narrow at its neck, though wide at its fundus, receives a portion of the intestine, which in the following case was too large either to be returned into the abdomen, or to retain its function whilst it continued in the sac."

I have purposely copied verbatim Cooper's description of this form of hernia. Barring a few slips of minor importance which are perfectly excusable for the state of knowledge of embryology in his time, there is no doubt that Cooper intended to describe a hernia in which the true hernial sac bulged into a lower hydrocele sac, both of which were adherent, in fact were one.

4. INFANTILE HERNIA

In the chapter on hernia previously mentioned, I made the following statement in dis-

[1] Cooper evidently thought first, that the case was a "congenital hernia" so-called.

[2] Very vague.

[3] It is to be noted that in Cooper's time the external ring was known as the "ring." This being so, Cooper's conception of the hernia is somewhat akin to that of a hernia into the funicular process.

cussing "infantile hernia," which bears repetition.

"The term 'infantile hernia,' is another misnomer. Some authors describe a hernia in which the maldevelopment is practically identical with that of an encysted hernia; but the hernial protrusion, instead of becoming invaginated into the preformed lower sac, descends behind it; to this form they have applied the vague term 'infantile hernia.'"

"I see no necessity for this subdivision; there is no material difference between the two forms of hernia."

I thought I was extremely guarded in my statement, and certainly made no claim of ever having personally encountered one. I confess that when I wrote that article, I had some misgivings whether I made myself perfectly clear. At the same time, I thought a brief mention at least appeared to be justified. Much to my regret even this guarded statement has been misunderstood. I determined to trace once more the term "infantile hernia" to its original source.

Hey (7) used the name "infantile hernia" for the first time in literature. Possibly the name suggested itself to him, because the hernia occurred in an infant of fifteen months, for there is certainly no other plausible reason for having selected it. He describes the hernia as follows:

"I found the tunica vaginalis was continued up to the abdominal ring, and inclosed the hernial sac; adhering to that sac, by a loose cellular substance, from the ring to within one-half inch of its inferior extremity . . . .[1] The interior or true hernial sac was a production of the peritoneum as usual and contained only the cæcum or head of colon . . . . Having removed the proper hernial sac I examined the posterior part of the exterior sac; and found it connected with the spermatic vessels in the same manner as the tunica vaginalis is, when the testis has descended into the scrotum."

Hey then goes on to describe the process of the normal descent of the testis, and finishes with a description of what he considers to be the true pathological explanation of the occurrence of such a hernia. As it is of some importance, and in order to settle the question, I may be permitted to copy his explanation verbatim. It is as follows:

"In the hernia which I am describing, the intestine was protruded after the aperture in the abdomen was closed; and, therefore, the peritoneum was carried down along with the intestine and formed the hernial sac. It is evident also that the hernia must have been produced while the original tunica vaginalis remained in the form of a bag as high as the abdominal ring, on which account that tunic would receive the hernial sac with its included intestine, and permit the sac to come into contact with the testicle." (In other words, Hey describes an encysted hernia, but he spoils it all by adding another sentence, which renders his idea and observation most difficult to understand—unless by the word "contact" he means proximity but not actual contact.)

The points of greatest importance in this description of hernia are the following: (1) that Hey called this hernia, and used for the first time the words "infantile hernia" (I have already pointed out that the term is a bad one; that it does not mean anything; that perhaps Hey used it because he encountered it in an infant); (2) that Hey practically describes the same kind of hernia as Cooper described; (3) that Hey antedates Cooper in the discovery and accurate description of this hernia by several years.

As a sort of commentary of the above I have attempted to see what later writers had to say upon the subject, but have finally arrived at the conclusion that it would only tend to confuse the topic still more.

[1] Vague.

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LEVATOR HERNIA (PUDENDAL HERNIA)

Report of a Case[1] Operated Upon by Combined Route; Review of the Twelve Previously Reported Cases

By HERBERT C. CHASE, M.D., F.A.C.S., New York

IN consideration of the extreme rarity of this condition, its little understood anatomical and pathological features, and the consistent failure of all operative measures for its cure in the past, I feel that sufficient interest exists to warrant my early publication of this case, although only a year has elapsed since operation—too short an interval, of course, to speak of a cure.

DEFINITION AND CLASSIFICATION

Pudendal hernia, as the name implies, is a hernia located in the pudendum. The term is misleading because other types of herniæ, inguinal, etc., may also have their termination there. Contrary to the usual rule, the final resting place of the hernia, instead of its exit, determines its name, which is further misleading. Von Winckel has suggested the descriptive term "subpubic hernia." As the essential anatomical feature is a rent in the levator muscle and its fascia (and adhering to the rule of naming herniæ in reference to the point of exit), we believe the term "levator hernia" as suggested by Blake to be the most appropriate.

Further classifications and subdivisions have been attempted leading to greater confusion. Some have stated that herniæ, having their point of exit behind the broad ligament, should be called "perineal herniæ." This is obviously wrong, because, although piercing the levator behind the broad ligament, the hernia may, in passing forward under the broad ligament, carry bladder with it as a part of the sac and still emerge in the labium above the transversus perinei muscles as in my case. Furthermore, a hernia anterior to the broad ligament, may break away the transversus perinei muscle at its point of exit and appear at the perineum, the transversus perinei muscle being the acknowledged boundary line between pudendal or subpubic herniæ above and perineal herniæ below. (Patient in dorsal position.)

Where all this confusion exists it would seem timely to suggest a classification and nomenclature based on the anatomy, which would give a clear indication of the exact site and structures involved. Therefore the following classification is suggested, including under the broad term "levator hernia" all the subclasses, because as stated above the essential feature—point of exit of all these herniæ—is the levator muscle and fascia.

Levator hernia:

1. Congenital
   a. Anterior to broad ligament
   b. Posterior to broad ligament
   c. Combined (anterior and posterior)
2. Acquired
   a. Anterior to the broad ligament
   b. Posterior to the broad ligament
   c. Combined (anterior and posterior).

HISTORICAL

Pudendal hernia is a condition of extreme rarity; the case which I am about to report being the thirteenth in literature.

It has always been considered incurable and of the thirteen reported cases, attempts at operative relief have been undertaken in only five. Only one has been reported cured (Case 12—Grattan). One case (Moschcowitz—Case 11) had seven major and many minor operations without relief.

To Sir Astley Cooper is usually ascribed priority in reporting cases of this type of hernia. However, he was preceded by Méry, who in 1739 reported in the *Transactions of the Royal Academy of Sciences*, of Paris, the following case:

Case 1. Reported by Méry. The hernia was found in a female 5 or 6 months pregnant—age not given. It was somewhat larger than an egg and disappeared on compression. The contents were evidently bladder. The description of this case is not sufficient to differentiate it from ordinary vaginal cystocele. It is, however, included in von Winckel's list of pudendal herniæ.

[1] From the Clinic of the Woman's Hospital.

CASE 2. Reported by Curade. Cooper was also preceded by Curade, who in 1769, in the *Transactions of the Academy of Surgery* of Paris, reported the following case:—The patient was a female of 26 years of age and was 6 months pregnant. On examination a lateral perineal tumor was found which increased in size on standing, or when the patient refrained from urinating for a long time. It was soft and painless. When compressed manually there arose a desire to urinate, and if pressure was continued, urine was actually pressed out. After confinement the hernia disappeared but returned in a subsequent pregnancy.

Curade states that he has no doubt that the case was one of pudendal hernia. The description of the physical signs and findings are so accurate, and all point so strongly toward an involvement of the bladder, that I believe that there is not the slightest doubt that this case can be placed in the list of true pudendal herniæ.

Nevertheless it is Sir Astley Cooper to whom we are indebted for the first detailed and complete reports of this rare condition. In his excellent monograph on herniæ, published in London 1807, he reported the two following cases:

CASE 3. Reported by Cooper. This case was a female, age 22, who had a hernia the size of a pigeon's egg for a long time and which she had always been able to reduce. When Cooper saw the patient, he found a swelling situated below the middle of the left labium, while the upper part of the labium and the inguinal ring were free from any swelling. The tumor extended upward alongside of the vagina nearly as far as the uterine os. The hernia gave an impulse on coughing. Cooper succeeded in reducing the hernia by taxis. In doing so the hernia disappeared upward with a gurgling noise and relief of all symptoms. After reduction of the contents the labium was flaccid, and a finger introduced into this flaccid sac could be passed upward into a circular orifice on the inner side of the ischium, between it and the vagina. Subsequently a "T" binder was used to retain the hernia.

(The above is a verbatim copy of the history from Cooper—in spite of the brevity of the report there is not the slightest doubt that this is a true case of pudendal hernia. It is to be regretted that the anatomy of the hernial ring is not described in detail.)

CASE 4. Reported by Cooper. This case is merely mentioned in connection with Case 3—the report of same is even shorter. Female, age not given, who had a swelling similar to but smaller than the preceding, and situated in the right labium. It disappeared in the recumbent posture, but reappeared promptly when the patient stood up. Dilated on coughing.

Chronologically the next case reported is that of a contemporary of Cooper—Cloquet—a surgeon who has written extensively on the subject of hernia.

CASE 5. Reported by Cloquet. Under the title "*Sur une hernie vulvaire*" this author publishes the following case: Female, age 24, complained of a swelling in the vulva. On examination, Cloquet found in the posterior part of the right labium majus, a round swelling the size of a large chestnut, which stretched the overlying skin and also extended toward the inner surface of the external genital. The swelling was slightly tender and extended upward alongside of the vagina; it became much more tense on standing and coughing and gradually increased in size. The patient noticed the swelling for the first time, only 14 days previously, and she believes that it was caused by straining at her work and at stool. Cloquet was able to reduce the swelling by taxis, the reduction being accompanied by a gurgling sound. After reduction a finger could be invaginated into the labium, whereupon a rounded opening was noticed between the vagina and ramus of the ischium. Nothing further was done but the patient immediately felt relief of her symptoms, nor has the hernia recurred since.

CASE 6. Reported by Hartmann. This operator reports that he has performed an autopsy upon the body of a female who had suffered for a long time with symptoms of a vesical calculus. At the autopsy there was found a tumor in the labium, which was formed by a portion of the prolapsed bladder. (It is to be regretted that the exact autopsy findings are lacking in this case; on that account it is very difficult to differentiate it with precision from ordinary cystocele.)

CASE 7. Reported by Hager. This surgeon, under the caption "*Vorderer Mittelfleischbruch bei einem Weibe,*" describes the following case:—The patient was a female, age 28. During her first confinement, which was very difficult, the patient noticed in the middle of her right labium majus, a swelling the size of a walnut. It decreased in size in the recumbent posture, but became larger on standing or walking; it was easily replaced but reappeared promptly. The swelling increased slowly in size during the subsequent 4 years, and then increased suddenly, became painful and softer. Poultices were applied, whereupon the swelling opened spontaneously at two points, discharged a quantity of blackish fluid and decreased in size. Seven months later in the course of a second pregnancy, the swelling became more annoying, on which account the patient entered Hager's clinic. At the examination, there was found a swelling the size of a pigeon's egg which occupied the right labium majus. The labium majus had disappeared by being stretched over the tumor. The vagina was pushed over to the opposite side by the pedicle of the swelling which passed upward between the vagina and ascending ramus of the ischium. The swelling was very tense and elastic and both painful

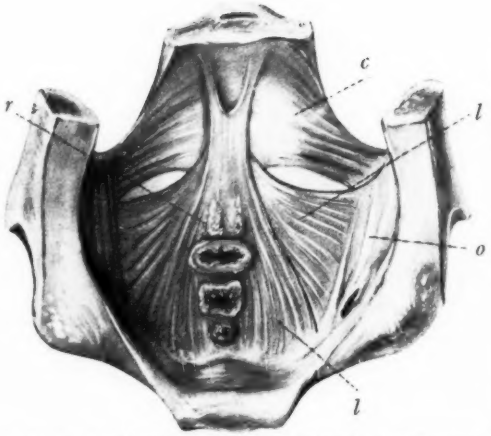

Fig. 1. Showing the weak points in the pelvic diaphragm above—the beginning of levator herniæ internally. *r*, Rectococcygeus: *c*, coccygeus: *l*, levator ani, and *o*, oblique fascia.

and tender. Hager diagnosed an anterior perineal hernia (pudendal) which was inflamed and also mildly incarcerated. Under local treatment these symptoms disappeared and finally the patient was discharged just prior to full term delivery.

CASE 8. Reported by Koenig. Speaking of pelvic herniæ, this author says that the most frequent forms are those which descend alongside of the vagina in front of the transversus perinei and then make their appearance upon the surface in the labium majus. He saw one such case which had the size of a man's head—detailed description is not given.

CASE 9. Reported by von Winckel. In this case the patient was a female who had been confined a number of times; all deliveries were difficult; the last time forceps had been used. Even prior to this last confinement the patient noticed a swelling in the right labium majus. Upon the mesial surface of this swelling another smaller swelling formed, which also increased in size and made quite a projection. On examination a swelling larger than an adult's fist was seen occupying the vulva, and more particularly occupying the part of the right labium majus. It was situated anteriorly and to the right of the perineal body and was bounded externally by the tuberosity of the ischium, and anteriorly by the right half of the symphysis pubis. Even on casual inspection it was seen that the swelling was made up of two different parts; namely, an outer one belonging to the labium and an inner one belonging to the introitus. On careful examination the smaller inner swelling was recognized to be the everted bartholinian gland. In the larger portion, or hernia proper, various structures could be palpated. By manipulation and pressure along the right side of the vagina, most of the hernial contents could be replaced into the pelvis; one smaller body, which was taken to be

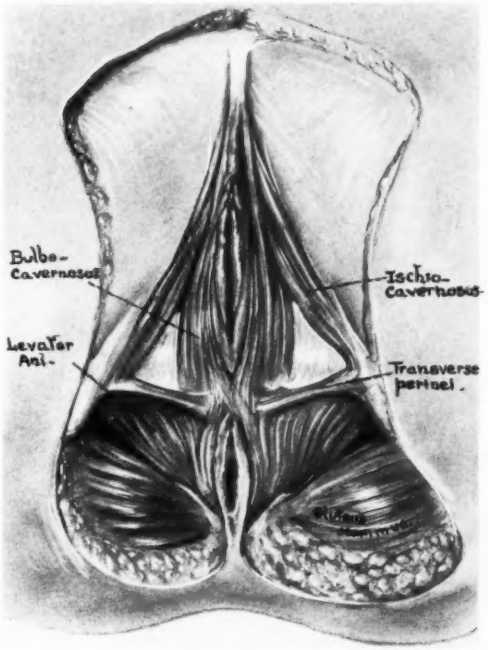

Fig. 2. Showing the "subpubic" triangle and its boundaries through which all true levator herniæ must emerge.

the ovary, could not be replaced. Treatment with a pessary and a truss was tried first but was absolutely unsuccessful. Von Winckel, therefore, tried a plastic operation *per vaginam*, which was followed by slight improvement, but failed as a cure.

Von Winckel reviewed the published cases of pudendal herniæ and reports the following additional one:

CASE 10. Reported by von Winckel. This patient was a female, age 51, after being in labor for 3 days, and after many attempts of delivery with forceps, she was delivered by perforation. At the age of 46 years, she noticed accidentally, a swelling in the right labium which gave rise to very few symptoms in the beginning, but to many subsequently. The swelling was reducible, and when reduced, an opening could be palpated underneath the symphysis. Von Winckel made many attempts to treat the patient with a truss, but without avail, and in consequence he decided to operate. The operation was carried out in the following manner:

Through a median laparotomy it was ascertained that the intestines were so adherent to the sac that they could not be liberated; therefore, the proposed closure of the sac from within the abdomen was abandoned and a ventral fixation of the uterus per-

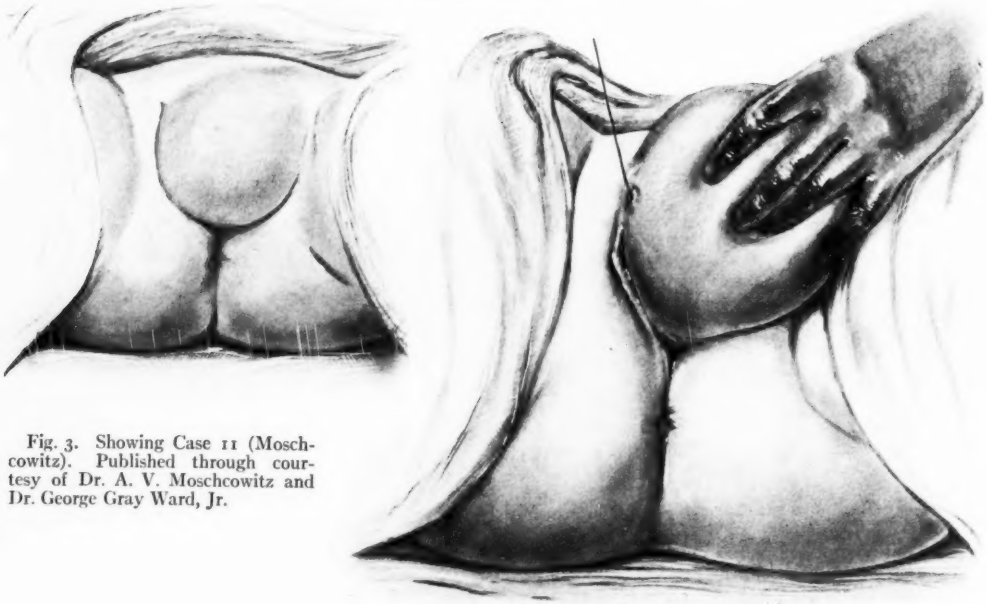

Fig. 3. Showing Case 11 (Moschcowitz). Published through courtesy of Dr. A. V. Moschcowitz and Dr. George Gray Ward, Jr.

formed as a substitute. For a short while the condition was improved somewhat, but a recurrence followed very soon and the patient was operated upon a second time. At this operation the sac was split up from below, the contents were reduced and the sac obliterated by suture. The patient was greatly improved by this operation but not cured completely. A small hernia still remained which grew only slightly during the next 15 years.

CASE 11. Reported by Moschcowitz—(verbatim copy of report by Moschcowitz). Mrs. E. L., age 41, history prior to 1895 is irrelevant. Delivered by forceps at termination of first pregnancy November 18, 1895. Indication for forceps not evident—pelvis ample size. Shortly after delivery a mass protruded from the vagina and coincidentally with it an incontinence of the bladder was also noted. The condition was first looked upon as one of paralysis of the bladder and a good prognosis was given. The condition, however, did not improve and after being seen by a large number of consultants, she finally came under the care of Dr. F. Lange, formerly of this city, who diagnosed for the first time a "Vaginal Rupture of the Bladder" with complete loss of the urethra and also an ununited fracture of the left pubic bone. Since that time the patient was operated upon a number of times. Only the operations of a major nature are mentioned here. The first major operation was undertaken December 30, 1895, and surprisingly was perhaps the one followed by the greatest amount of success. It consisted of a closure of the defects of the bladder and the formation of a new urethra of the left labium minus. After this operation patient regained control of the bladder.

The second major operation was undertaken May 10, 1896. The previously mentioned vaginal protrusion, which the operator recognized as a hernia, was pushed back and the opening closed by some sort of a vaginal plastic. This operation was not in the least successful; the hernial protrusion recurred immediately, whereupon the patient was informed that before another attempt at its radical cure could be made, it would be absolutely necessary first to repair the fracture of the pubis.

The third major operation was therefore undertaken in January, 1897. The patient was told that the ends of the fractured pubic bone were refreshened and sutured with silver wire. Unfortunately the wound became infected and had to be reopened. Intractable sinuses formed throughout the length of the incision until the silver sutures were removed about 6 months later; at the same time another unsuccessful attempt was made to cure the hernia by a vaginal operation. This may, therefore, be called the fourth operation.

A fifth unsuccessful attempt at a cure was undertaken in June, 1899.

Thereafter the patient abandoned all hope at a cure for 9 years.

In 1918 the patient again became pregnant and was delivered prematurely by a breech presentation. After this confinement the hernia increased marked-

ly in size; it also became evident, for the first time, that the hernia contained not only the bladder but also intestines. The patient was a total invalid; she became bed-ridden and suffered a great deal of pain and untold inconvenience from the hernial protrusion; a particularly annoying symptom was the inability to empty her bladder unless she first reduced the hernia manually.

She therefore readily consented to a sixth attempt at a cure, which was undertaken March 31, 1913, by Dr. Robert Abbe, to whom I am indebted for the following notes: This operation was the first attempt at a cure by the abdominal route. The hernia in the depth of the pelvis was exposed; its contents were found to be the bladder and about 3 feet of small intestines. These as well as the hernial sac were drawn back, and after putting the sac on the stretch to the utmost, the opening was repaired by a sort of cystopexy, the bladder being fixed by six sutures of Pagenstecher linen to the peritoneum and fascia of the anterior abdominal wall. For a while this seemed to fulfill the intended design; however, soon after the patient was permitted to be up and about the condition recurred.

I saw that patient for the first time May 15, 1913. My physical examination revealed the following status: A well-healed median abdominal scar. A protrusion in the left labium, about the size of an adult fist was noted; this protrusion was dull on percussion and imparted an impression of translucency; it was reducible, but upon the slightest attempts at reduction the patient felt an uncontrollable desire to urinate. The swelling was so large that its mesial surface, having pulled the vagina down, was covered with mucous membrane. The introitus vaginæ was crescentic, with the convexity toward the right. The left labium minus was absent (result of previous operation). The vestibule of the vagina was so distorted that at first I was entirely unable to find any urethra; finally after a great deal of search I was able to discern an orifice, or better said, the opening of a fistulous tract high up, hidden underneath the symphysis, which on probing led in a tortuous manner upward and to the left into the bladder. Entire vagina was occupied by a protrusion which came down along into left side. When the mass was reduced there was to be felt to the inner side of the descending ramus of the pubis a longitudinal hiatus, easily admitting four fingers. The internal organs were negative to palpation.

The history and physical findings were not very encouraging for a radical cure. The patient, however, was so willing and even insisting, that I finally acquiesced to her pleadings and consented to make another attempt in a manner not hitherto tried.

This operation was performed May 27, 1913. Median laparotomy extending from the symphysis pubis to one inch above the umbilicus. Massive adhesions were encountered at the site of the last operation. After liberating the adhesions it was seen that the hernia was of the sliding variety, involving the left half of the bladder. This was very discouraging because at the very outset it prevented me from at least extirpating in a thorough manner the hernial sac as I hoped to do. The small intestines were adherent in the depth of the sac and were freed.

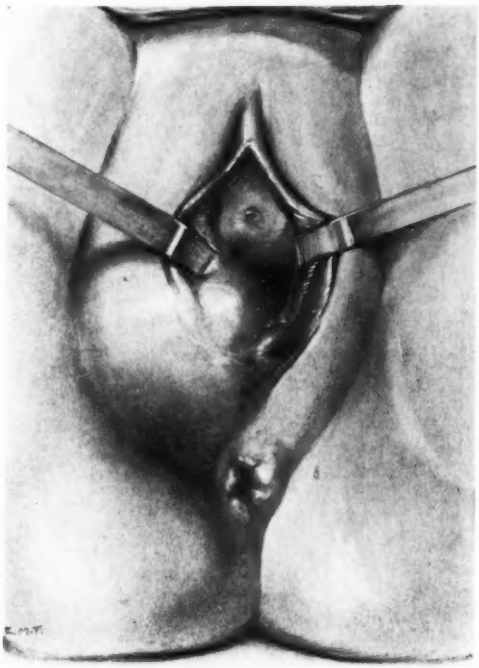

Fig. 4. Showing the "levator hernia" before operation. Note position of sac (through subpubic triangle) and that its internal surface is covered with mucous membrane and external surface with integument.

The hernial ring was a large, irregular oval, easily admitting the folded hand, and was bounded externally by the ascending ramus of the pubis, and mesially by the soft tissues of the bladder, uterus, and vagina. The problem of a cure, therefore, resolved itself into the question of my ability to close this opening. Neither pelvic fascia nor levator ani were available. I believe both were ruthlessly torn away at the original forceps delivery. I, therefore, deliberately carried out an operation I had evolved in advance, namely to dislocate the uterus and to use it as a plug for the hernial opening.

In order to enable me to do so, I first extirpated the right ovary and both tubes. After incising the pelvic peritoneum anterior to the left broad ligament, the uterus was dislocated into an extreme sinistro version and fastened in its new position with a number of Pagenstecher sutures to the descending ramus of the pubis. Had the uterus been only a trifle larger, or the hernial ring only a trifle smaller, it would have been possible to close the hernial ring

Fig. 5. Abdominal route. Showing the pregnant uterus displaced to left and loop of sigmoid piercing right broad ligament. Dotted lines indicate knuckle of bowel pulled up from sac; median incision seen from above and behind uterus.

completely; as it was the lateral portions only could be obliterated, and no matter what I did there still remained a weak area to the right of the dislocated uterus which could not be closed. The best I could do under the circumstances was to pull up the vagina and bladder and suture these organs to the dislocated uterus. The duration of the operation was 2 hours. The convalescence was exceedingly stormy. The patient vomited almost continually for a number of days. Temperature and pulse, however, remained normal. Primary union resulted and the patient was discharged June 19, 1913.

I kept the patient under observation and for some time after the operation she was very comfortable. However, about one year after the operation, I found on examination, that the uterus was again in its normal vertical position—no more sinistroverted and that there was again a hernial bulging. I heard from the patient the last time just one year ago, at which time the hernia had recurred to practically its former dimensions.

CASE 12. Reported by Grattan. (Verbatim copy as published by Grattan.) Mrs. M. F., age 53, came to me in July, 1918, for relief of the condition which she described as "irritation in the rectum with difficulty in moving the bowels and in addition a bearing down sensation in the vagina," ascribed by two physicians, who had examined her within a year, to falling of the womb. The rectal trouble was further described as "a desire to empty the bowels often quite urgent but without result except with the aid of an enema."

The inception for this trouble dated back 4 or 5 years, but remained quite tolerable to within a few months preceding her first visit, when the attacks increased in frequency and severity causing considerable worries and discomfort. She had never noted any blood in the stools. She added that her brother had died recently following an operation for cancer of the rectum. Naturally, I ascribed her concern to the recent family loss but decided to use the proctoscope as a part of the physical examination.

The marital history showed three pregnancies including a difficult twin delivery with loss of one of the twins as a result of a protracted labor. Patient had always done hard physical work about the house through necessity. The condition mentioned as falling of the womb was regarded by the patient as the usual legacy of a hard working mother of several children, but the rectal trouble caused her real concern.

Physical examination. General survey—an obese type woman of middle age, height about 5 feet, 4 inches, color slightly cyanotic, facies slightly suggestive of a nephritic condition. Slight dyspnœa on exertion. Thyroid, heart, lungs and extremities show nothing of interest. Abdomen pendulous—no umbilical, femoral, or inguinal hernia. Urine shows faint trace of albumin. Local examination—vaginal examination showed nothing unusual except it be the well-retained vaginal walls without a suggestion of cystocele or rectocele, and a small well-located uterus—all of which argued against prejudice created by the history in favor of a prolapse of the uterus. The cervix was small and normal; vulva normal. Digital examination of the rectum was negative. There was no prolapse; no hæmorrhoids; proctoscopy revealed nothing to account for the symptoms.

I decided to reassure myself by repeating the vaginal examination. With the examining fingers of the right hand in the vagina, I told the patient to hold her breath and strain downward—nothing happened. I asked her to cough several times. All these procedures failed to cause any perceptible descent of the uterus; but as she repeated the cough I thought I felt an impulse against the back of my examining hand. I had her repeat the cough ten or twelve times. As she did so I observed and felt a definite impulse in the adductor region of the left side. A mass the size of a hen's egg developed at the site of the impulse. The mass was soft, reducible, and gurgling occurred on manipulation. The location was crescentic area external to the left labium majus, but not involving that part. The gurgling, the definite impulse on coughing and the reducibility upward of the mass satisfied me that I had found a hernia containing intestine in an unusual location. Patient complained that my manipulations reproduced to some degree the symptoms referable to the

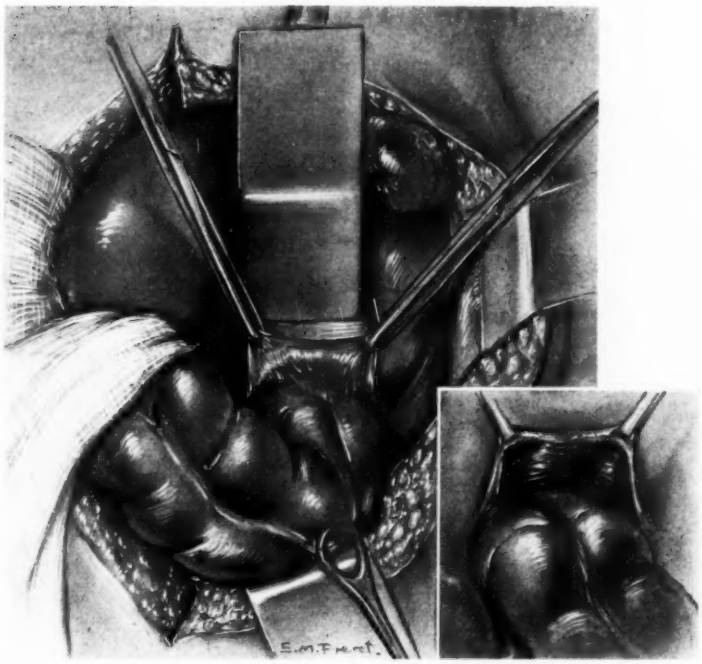

Fig. 6. Abdominal route. Showing the sac pulled up partly after reduction of loop by traction. Insert shows peritoneal edges of sac held up with fascia showing below after circumcision of margins as indicated by dotted line in large picture.

rectum, and also gave the sense of bearing down formerly ascribed to falling of the womb. To repeat I knew that she had a hernia but to explain its course of descent was a real problem. In a general way I argued that it must have emerged through some rent in the pelvic floor, occasioned by muscular separation during the difficult twin labor. I hoped that exploration would throw further light on the true anatomy of the condition.

Operation. Seeing no advantage to approaching from below and feeling that I would loose my landmarks in following the sac from below upward, I chose the abdominal route. A suprapubic incision extending from the symphysis to the umbilicus was necessary on account of the extremely fat abdominal wall. The exposure of the pelvis was difficult because of the great amount of intra-abdominal fat and the risk of the exaggerated Trendelenburg position with an adipose subject. Exposure of the pelvic organs finally revealed descent of the sigmoid loop to a triangular opening in the floor of the pelvis. This opening was bounded anteriorly by the posterior reflexion of the left uterosacral ligament; laterally and posteriorly by the rectum. The sigmoid being fixed at its point of continuation into the rectum appeared to slide down along the posterior surface of the broad ligament and disappear through the hernial opening. Practically the entire loop was out of view. Much to my surprise gentle traction brought the entire sigmoid loop out of the sac. There were no surface adhesions and no evidences of constriction at any point. The opening was triangular in outline, with the uterosacral ligament forming the base, the reflexion of the broad ligament the anterior arm and the rectum (in an irregular sense) the posterior arm of the triangle. I inserted my left index and middle finger downward into the sac and had the nurse uncover the inner side of the left thigh, and identify the fingers through the skin covering the sac. There was no process of the sac descending into the left labium as in the cases of pudendal hernia reviewed by Moschcowitz. However, the exit and course of the descent was undoubtedly the same; the final destination being the subcutaneous tissue of the upper adductor region of the thigh rather than the labium.

Gross surgical anatomy. The protrusion undoubtedly occurred through a rent in the levator ani muscle and passed through the triangle, bounded externally by the ischiocavernosus, internally by the constrictor cunni and posteriorly by the transversus perinei, and along the left lateral wall of the vagina

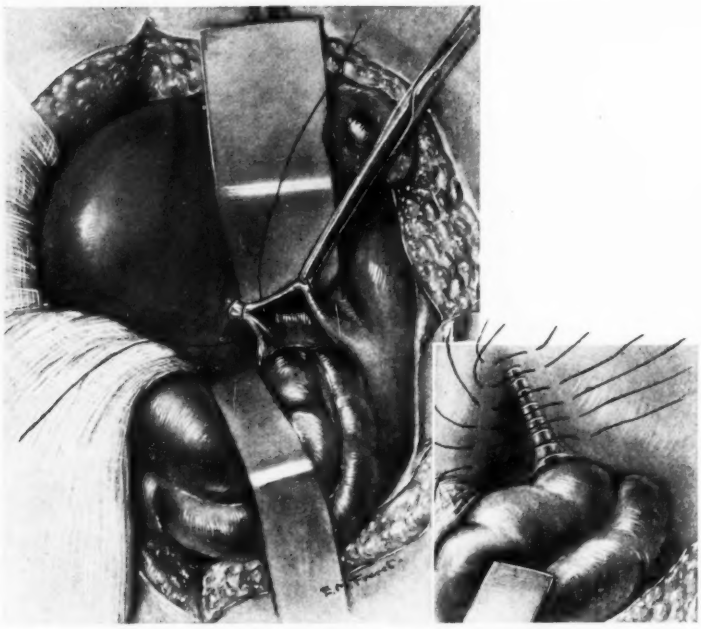

Fig. 7. Abdominal route. Showing the fascial closure (rectovesical—true pelvic fascia) beneath peritoneum. Peritoneal edges not well shown above fascial split. Insert shows second row of sutures of peritoneum, unfolding the fascial layer.

emerging in the thigh. The split of the levator was probably the result of the difficult twin labor mentioned in the history. The rectal symptoms were undoubtedly due to the partial kink produced at the rectosigmoid junction when the sigmoid loop descended into the sac. The bearing-down feeling was a natural accompaniment of the hernia. The ready extraction of the sigmoid from the sac at the operation explained the spontaneous reducibility and freedom from symptoms in the intervals.

Closure of the ring. Needless to say no attempt was made at extirpation of the sac. Its depth, adipose status of the patient, her age, as an argument against prolonging the anæsthetic needlessly precluded this. With great effort and difficulty I passed five or six mattress sutures of double Pagenstecher linen across the long arms of the triangle and succeeded in closing it tightly and completely. To make doubly sure I whipped a continuous suture over the line of mattress suture taking another reef in the broad ligament. This last step caused a version of the uterus backward and to the left, superimposing the fundus over the site of the hernial opening. The sigmoid was anchored to the left psoas muscle, the brim of the pelvis and again about 2 inches above that point, the idea being to prevent its descending to its habitual location in the vicinity of the hernial opening. The abdomen was closed by layer sutures. The patient made an uneventful recovery. Mineral oil was used for 6 months following the operation to secure daily evacuation. This is not necessary at present. The sense of prolapse and rectal irritation have never been experienced since the patient left the hospital. Two years have elapsed and repeated examinations failed to show recurrence.

Epicrisis. While the point of entrance (or internal ring) of the hernia was evidently the same as that of a pudendal hernia there is nothing further to demonstrate the variety. The point of exit was not demonstrated nor was the exact position of the sac. The fact that it apparently did not involve the labium would lead one to believe that the point of exit was behind or posterior to the transversus perinei from whence it dissected up the adductor region of the thigh. In other words there is apparently nothing which definitely distinguishes it from the more common perineal herniæ. A true pudendal hernia must emerge through the subpubic triangle, must involve the posterior part of the labium, and must be covered mesially by vaginal mucosa and externally by integument.

Through the courtesy of Dr. George Gray Ward, Jr., chief surgeon of the Woman's

Hospital, in whose service the following case was operated upon by me—I will add to the twelve cases previously reported the thirteenth, as follows:

Mrs. H. A., Woman's Hospital. History No. 26906, admitted December 6, 1920; discharged February 2, 1921. Chief complaints: (1) Pain of bearing-down character in lower right quadrant of abdomen; (2) bearing-down feeling in the right labium and vagina; (3) sense of pressure and bearing-down feeling in rectum and in bladder when coughing, straining, etc.; (4) a feeling as if everything is dropping out and has to hold hand over right side of perineum when straining at stool, during urination, etc.

The family history is negative. Patient has had no illnesses, except diseases of childhood. Menstruation began at 15, always regular, 28-day type, lasting 3 days, moderate flow, no pain. Married 16 years, six children, three miscarriages, all spontaneous at about third or fourth month. Oldest child 14 years, youngest 17 months. All normal deliveries except the last which was a forceps delivery and patient was in labor 28 hours.

Present Symptoms. Twenty-one months ago, when patient was 4 months pregnant, while working in a mill, felt sudden sharp pain in lower right quadrant, and in vagina and rectum, with bearing-down sensation, as if wanted to move bowels and could not. Pain became severe in half an hour and she was taken home, given some pills and a hypodermic and put to bed. Vomited the medicine and continued to vomit daily for a week, with continuous pain, slight fever, bearing-down sensation and could not get bowels to move. Markedly distended for a week. Given enemata and cathartics daily and finally bowels moved on the seventh day. At the onset of the pain the bulging of the vagina was noticed for the first time, and has remained since but seemed larger during the attack. Throughout the remaining 5 months of her pregnancy, the bulging was a constant annoyance and had to be held with the hand when straining at stool, urinating, etc. When labor started in at term the bulging became larger, and after the membranes ruptured, and the head came downward with each contraction, the lump got bigger and pain more intense; and then receded with the abeyance of each pain. Also vomiting was constant throughout the labor. The doctor came and tried to push the mass above the baby's head, but could not and gave her chloroform after summoning another doctor to help, and used forceps. This took 2 hours. The child was normal, weighing 8¼ pounds. Patient was in bed for two weeks.

After delivery no vomiting or fever occurred, but the rupture got bigger and had to be held with the hand on straining, and bowel movements and urination were very painful. Since then the bulge has gradually gotten bigger requiring holding with each defæcation and urination.

Fig. 8. Abdominal route. Showing final steps of closure of internal ring or entrance of levator hernia internally. To close triangle base of right broad ligament is brought over to cervix and right sacro-uterine ligament. Intestine fixed by rectopexy stitch to avoid "sliding."

Physical examination. A general survey shows a rather obese, well-developed young woman of good color. Height 5 feet, 5½ inches; weight, 170 pounds. Heart and lungs normal; abdomen obese and pendulous, otherwise negative. No umbilical, inguinal, or femoral herniæ.

Local examination. A protrusion was seen in the posterior part of the right labium, the size of an adult fist. It was semi-resonant to percussion, easily reducible, with an impulse on coughing. On attempts at reduction the patient felt a sense of pressure high in the rectum and a desire to urinate. When the mass bulged on coughing or straining, its mesial surface was covered with mucous membrane of the vagina, and its external or right surface with integument, and the mass occupied the posterior half of the right labium. The vagina was crescentic with convexity toward the left. On straining the entire vagina was occupied by a soft mass which came downward on the right side parallel with the vagina. When the mass was reduced the labium was left flaccid and redundant, and passing the fingers upward and inward through the flaccid labium, along the right lateral wall of the vagina, an irregular, ovoidal hiatus, could be felt on the right side of the vagina, bounded mesially by vagina and externally by the descending ramus of the ischium. This open-

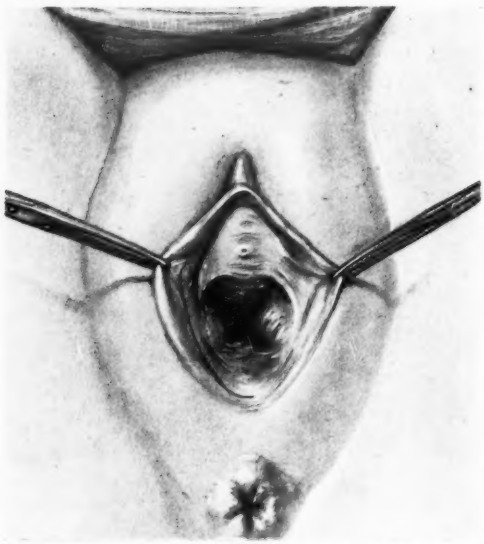

Fig. 9. Vaginal route. Showing the condition several weeks after completion of the abdominal operation. No evidence of hernia, normal parous vagina, primary incision.

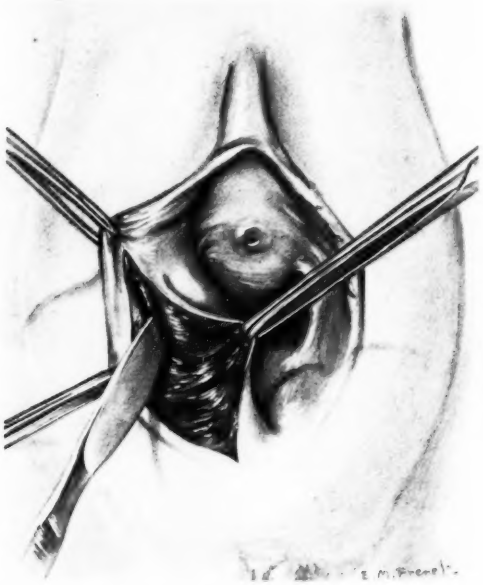

Fig. 10. Vaginal route. The dissection continued—separation of vaginal flap to expose subpubic triangle on the right side.

ing admitted four fingers which could be easily passed through it, palpating the pelvic organs on the right side. A curved sound passed into the bladder showed no cystocele, but the sound passed outward and downward could be brought through the hiatus and felt in the bulging sac. With the hernia reduced, proctoscopy was negative as was also digital examination of the rectum. With the finger of one hand in the rectum and the finger of the other hand in the vagina, the mass could be felt on straining to come down the right lateral wall of the vagina between the two examining fingers. The pelvic organs were otherwise negative except uterine pregnancy at third month, moderate laceration of perineum and bilateral laceration of cervix. No rectocele or cystocele.

Operation. The diagnosis of pudendal hernia having been made, it was determined after consultation, that a therapeutic abortion should be done because of the strangulation of the hernia during the last labor, the fact that the patient had six living children, and further because we felt that this serious type of hernia, hitherto always regarded as incurable, should not be operated upon so close to the expected labor. Accordingly it was planned that the operation be undertaken in two stages: first, the therapeutic abortion and the operation by the abdominal route for reduction of the contents and closure of the ring; second, operation by the vaginal route for removal of the sac and plastic repair of the levator, fasciæ, etc.

Stage 1, abdominal route. Dilatation and curettage; salpingectomy, bilateral (sterilization); closure of hernial ring; sigmoidopexy.

Findings and operation. Examination under ether shows, when the patient is straining, a mass the size of a man's fist, bulging into the vagina on the right side, occupying the posterior part of the right labium. After curettage was performed and the usual products of conception of the third month removed, the uterus was packed with iodine gauze. The abdomen was then opened by a median suprapubic incision 5 inches long. The pelvic loop of the sigmoid was found to be very mobile, with mesosigmoid 7 or 8 inches long, the entire sigmoid loop being in the pelvis and the only fixed point being the recto-sigmoidal junction at the end of the mesentery. The sigmoid loop, by sliding with its mesentery and the upper portion of the rectum, had pushed forward and slightly to the right, behind and underneath the right broad ligament, at the junction of the right broad ligament and the cervix, just external to the junction of cervix and right sacro-uterine ligament. At this point, where there is normally a slight fossa, bounded mesially and internally by the right sacro-uterine ligament and anteriorly by the base of the right broad ligament, and externally to complete an imaginary triangle by a line drawn between these two points, the knuckle of bowel had, after partially tearing away the anterior end of the right sacro-uterine ligament, pushed forward and downward,

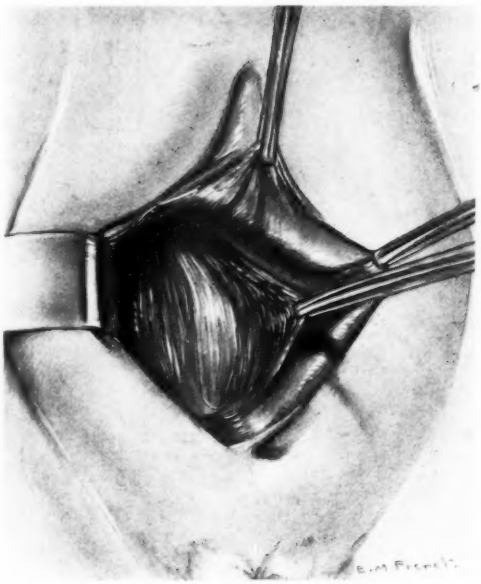

Fig. 11. Vaginal route. Showing the right levator muscle drawn over toward left and sac (now empty and not bulging) showing through split levator. Light area is sac showing through split in muscle.

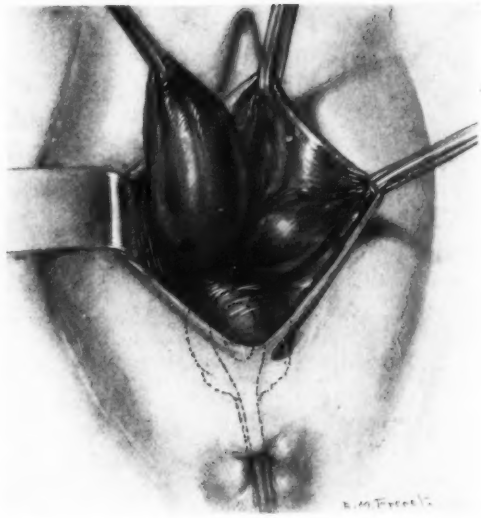

Fig. 12. Vaginal route. The sac has been separated from edges of split levator, and the inner bundle of split muscle pushed outward to join main body of right levator muscle and sac freed to neck. Sponge in rectum.

tearing a hole in the rectovesical fascia, which would easily admit three fingers. The loop of bowel having been lifted from this canal, two fingers were passed forward through the opening, under the right broad ligament forward and downward, when it was ascertained that the bladder (inferior and right lateral surface) remained in the canal. The bladder was then drawn up out of the sac and my assistant, passing two fingers through the vagina into the hiatus, brought his fingers into contact with my fingers above. I then had him attempt to turn the sac into the abdomen by pushing upward from below. The sac was adherent and this could not be done and after a few attempts this was abandoned, for we soon realized that the opening in the rectovesical fascia, above and behind the broad ligament, and the opening in the levator below and in front of the broad ligament, were so far removed (about 2 inches) from each other, that it would be impossible, without extensive dissection in a very vascular area, and complete mobilization of uterus and right broad ligament, to close the muscular hiatus as well as the fascial opening from above. In other words, we realized that we were dealing with a combined (anterior and posterior) variety of hernia and a combined operation would be necessary. We realized further that even if we were to close both of these openings from above, the opening in the pelvic (ischiorectal) fascia below would remain and the sac although cut off would remain. The fact that we were dealing with pregnancy and its accompanying vascularity was further argument against this extensive dissection. Therefore, we decided to content ourselves simply with closure of the ring, leaving the rest to be completed at the second stage through the vaginal route. The bowel was drawn out of the sac and held taut and the peritoneal margins of the ring were completely circumsized. This exposed to view the raw edges of the rectovesical fascia. This fascial opening was then closed with eight interrupted sutures of fine Pagenstecher thread. Above this a second layer was placed using six double fine Pagenstecher interrupted sutures for closure of the peritoneal edges covering over the first layer. To form an additional barrier the broad ligament, at the lower edge of its base, was brought over against the sacro-uterine ligament, thus joining the two arms of the triangle with five interrupted Pagenstecher sutures obliterating the fossa. Just mesially to this last line of sutures the rectosigmoidal junction was attached to this column by a single Pagenstecher stitch to prevent knuckling of the bowel at this point. The pelvic loop of the sigmoid was then drawn out of the pelvis and fixed by four sutures to the anterior surface of the psoas muscle and the peritoneum covering this muscle with four sutures of Pagenstecher thread (sigmoidopexy). Sterilization was then performed by removal of both tubes well into the cornua in the usual manner and closing the cornua with Pagenstecher thread. The abdomen was then closed in the usual manner—using three stay

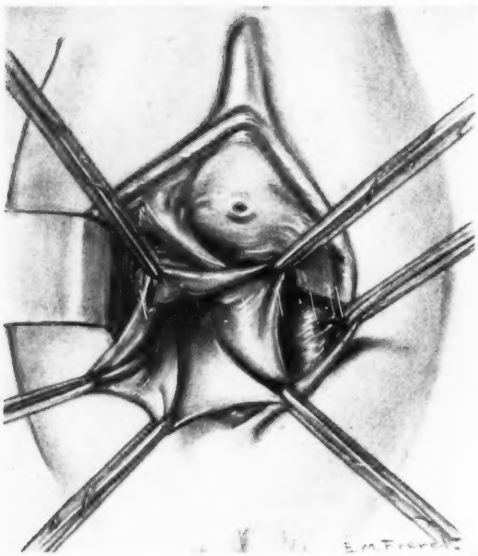

Fig. 13. Vaginal route. Empty sac split and held open. (Finger passed into sac could easily feel internal closure of fascia—see abdominal route. Figs. 7 and 8.)

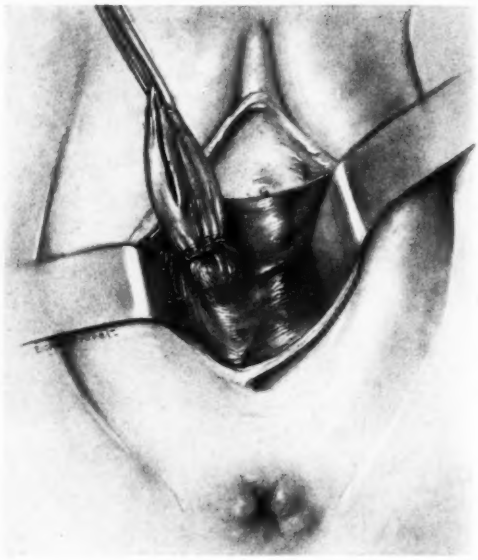

Fig. 14. Vaginal route. Transfixion and ligation of sac before excision. The sac was actually ligated at a higher level than represented here.

sutures of silk (B. & B.) and black silk for the skin. Convalescence was uneventful and afebrile. The abdominal incision healed by primary union. Her general condition remained good. On the twenty-third day, the patient not having been out of bed the second stage of the operation was undertaken as follows:

Stage 2, plastic repair. A curvilinear incision 3½ inches long was made beginning at the mucocutaneous junction high up within the right labial fold opposite the opening of the duct of Bartholin's gland, extending downward and across the perineum at the mucocutaneous junction to the same point on the opposite side. The mucous membrane, superficial fascia, and skin were dissected up, including the anterior layer of the triangular ligament, thus exposing the triangle (subpubic triangle) bounded internally by the constrictor cunni, externally by the ischiocavernosus muscle, and below by the right transversus perinei muscle. The hernial sac was seen to bulge through this triangle and through an opening in the split levator and ischiorectal fascia which would admit three fingers. The sac was pear-shaped, now being empty, and about the size of a large pear. The right levator had been split by the protruding mass so that a band about 1 inch wide of levator fibers was internal to the sac and the remainder of the levator external to it. The inner band of levator fibers was separated from the sac which was adherent to it and this band pushed outward. The adhesions of the sac to the split edge of the levator explained why it had been impossible to invert the sac into the abdomen during the abdominal operation. The sac was then freed up to its neck and split open. The sac was empty, lined with peritoneum on its internal surface, and a finger passed into the sac up to its neck felt the sutures firmly uniting the pelvic fascia above (these sutures having been placed during the abdominal operation). The split sac was transfixed at its neck with a suture of kangaroo tendon tied off and excised high. The stump was then carried outward to the right and behind the broadest portion of the right levator muscle and the sutures transfixing this were brought through the levator and sutured through and through also catching the reflexion of the fascia at the white line, thus fixing the neck of the sac against the posterior surface of the broad base of the levator. The torn levator was then repaired by suturing the two bundles together with three interrupted sutures of kangaroo tendon. The opposite levator was then dissected out and an ordinary levator myorrhaphy performed using five kangaroo sutures, suturing the muscle together in the median line. The torn and attenuated ischiorectal fascia was then repaired by suturing with interrupted stitches of fine kangaroo tendon. The mucous membrane was then closed in the usual manner with interrupted stitches of fine chromic gut, with excision of the redundant mucosa and a subcutaneous stitch closing the skin.

Following the second stage of the operation patient made a speedy and uneventful convalescence.

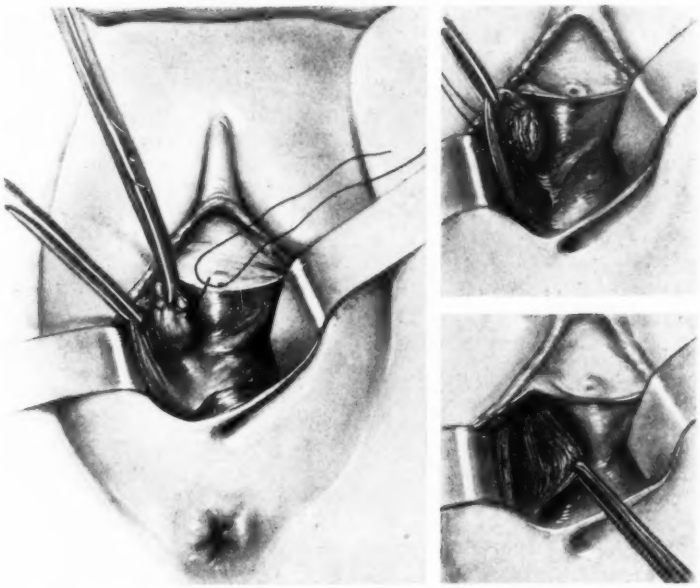

Fig. 15. Vaginal route. Showing fixation of neck of sac behind "white line" and behind the broad buttress of the right levator base. After this step an ordinary levator myorrhaphy and perineorrhaphy was performed.

She was allowed out of bed on the eighteenth day and discharged from the hospital on February 2, 1921 (fifty-second day). The discharge note reads as follows: Abdominal incision—primary union. Vaginal incision and perineorrhaphy—solid primary union. No protrusion or bulging—relieved of all symptoms.

The patient has remained perfectly well and free from all symptoms up to the present time, although through necessity she has worked hard. During the year she has had six follow-up examinations by myself and other members of the staff, all of which had failed to show any sign of recurrence. The only postoperative treatment has been a nightly dose of liquid petrolatum. The last follow-up examination, November 30, 1921, is as follows: Abdominal incision well healed and solid. Vaginal incision well healed and solid. No bulging or protrusion on coughing or straining; no sign of recurrence. Uterus in normal position, adnexa negative. (Examined by Dr. Ward, Dr. Farrar, and Dr. Chase.)

SURGICAL ANATOMY

So many intricate and interesting problems are presented in the mechanism and anatomy of this type of hernia that it would seem appropriate to describe more fully here the surgical anatomy of this condition.

1. *Point of entrance (or internal ring).* This may be anterior or posterior to the broad ligament, giving rise to three varieties: first, anterior or direct; second, posterior or indirect; or third, a sac originating behind the broad ligament may push forward under the broad ligament and break through the levator anteriorly, thus combining features and contents of both anterior and posterior types. To this we have given the name "combined type."

The point of entrance of the posterior variety or its beginning is at the weak point in the pelvic diaphragm internally. From a consideration of the anatomy and formation of the various layers of the pelvic diaphragm and from a study of dissections and by a reference to Figure 1, it will be seen that this weak point is at the three posterior divisions of the levator muscle. It is obvious at once that the lateral portions of the levator (m. ilio-coccygeus) does not overlap the central portion (m. pubo-coccygeus) laterally, but passes onward to fuse directly with the pubo-coccygeal and recto-coccygeal raphé. This

leaves a space on each side behind the broad ligament where there is no muscular covering and where the pelvic or rectovesical fascia is separated only by areolar tissue from the ischiorectal fascia, the two fascial planes being in contact, obviously a weak point. No such condition exists anterior to the broad ligament where the lateral (m. ilio-coccygeus) portions entirely overlap and fuse with the pubo-coccygeal portion of this muscle. This no doubt explains the predominence of the posterior variety (8 out of 11 cases reported) and further the fact that only the traumatic varieties are anterior (direct trauma). The internal boundaries of the posterior variety (i.e. of the ring) are then, the broad ligament anteriorly, the sacro-uterine ligament mesially, and an imaginary line between two areas of the triangle. The rectum forms (irregularly) part of the mesial boundary posteriorly. The boundaries of the anterior variety at the point of entrance are the uterus and bladder mesially, the round ligament externally, and below the vagina and the transversus perinei muscles, while the base is formed by the lineæ terminæ of the pelvis. The significance of the transversus perinei muscle as a boundary for differentiation between pudendal and perineal herniæ has already been pointed out in the classification.

Sac and contents. The sac is obviously longer and more definitely defined in the posterior variety (i.e. in herniæ originating posterior to the broad ligament). This is of practical importance because the surgical principles of high ligation of the sac and closure of ring are applicable always to this variety. This I wish to emphasize because, although pudendal hernia has been regarded as a hopeless surgical problem, the posterior variety at least is always amenable to surgical repair and to the application of the two principles mentioned above. Careful examination will determine whether a given case of pudendal hernia is of the anterior, posterior, or combined variety. In the first place with the hernia reduced, the point of entrance internally may be felt and its position relative to the broad ligament and uterus decided upon. Further, the contents of the posterior variety is usually gut alone with bladder or with ovary and tube, and the "combined" can easily be recognized by the fact that it contains both bowel and bladder. It may contain ovary and tube also, but always bowel and bladder, both of which can be recognized by symptoms and examination. The anterior variety always contains bladder. The practical bearing of recognizing the contents of the sac and type of sac (anterior, posterior, or combined) will be at once apparent in the description of the operation and pictures of same. In producing the three types of this hernia artificially in the three cadaver dissections, this classification as a practical basis for surgical repair became at once apparent. The posterior and combined varieties, containing bowel, are always of the sliding type.

In the anterior variety we find a more difficult and different situation. The sac is less defined and only partial because the bladder which forms the contents of the sac, is only partially covered by peritoneum—laterally and inferiorly—so that the hernia is necessarily of the para-peritoneal variety. The sac is, therefore, incomplete and its removal and closure fraught with far greater difficulties (Case 11—Moschcowitz exemplifies this).

Canal and course. The posterior variety passes downward and forward perforating the rectovesical fascia, then the ischiorectal fascia to its ring and exit to be presently described. It may pass through the levator or through the weak fossa above described, and pass forward guided by the ischiorectal fascia. The posterior variety may also burrow forward and downward under the broad ligament, perforating only the rectovesical fascia and become anterior to the broad ligament before perforating the levator, thus constituting the combined variety (containing both bowel and bladder). In the anterior variety, the course and canal with incomplete sac is obviously much shorter, passing directly downward and forward to the ring and point of exit.

External ring or point of exit. This is an irregular triangular area bounded externally by the ascending ring of the ischium and a part of the descending ring of the pubis, mesially by the vagina, and posteriorly by the transversus perinei. It is this ring that can be

TABLE I.—ETIOLOGY

Case No.	Author	Traumatic	Spontaneous	Age	Sex	Side	Contents	Operation and Result
1	Mery	Yes	No	Not given	F	Not given	Bladder	None
*2	Curade	Yes	No	23	F	Not given	Bladder	None
*3	Cooper	Yes	No	22	F	Not given	Intestines	None
*4	Cooper	Yes	No	Not given	F	Right	Intestines	None
*5	Cloquet	Yes	No	24	F	Right	Intestines	None
6	Hartmann	Yes	No	Not given	F	Not given	Bladder	None
*7	Hager	Yes	No	28	F	Right	Not given	None
*8	Koenig	Yes	No	Not given	F	Not given	Not given	None
*9	Von Winckel	Yes	No	Not given	F	Right	Intestines	Failed
*10	Von Winckel	Yes	No	51	F	Right	Intestines	Failed
*11	Moschcowitz	Yes	No	41	F	Left	Intestines	7 ops. failed
12	Grattan	Yes	No	53	F	Left	Intestines	Cured 2 years
*13	Chase	Yes	No	34	F	Right	Intestines	Cured 1 year

*Cases marked with (*) are proven cases of pudendal (subpubic) hernia.

easily palpated and digitally explored in these cases. The transversus perinei muscle forms the posterior boundary of the weak triangle of exit, which is covered only by two layers of the triangular ligament (thin fascial layers). The other boundaries of this triangle, through which the hernia passes after coming through the ring (these muscles also forming part of ring borders) are the constrictor cunni internally and the m. ischiocavernosus externally.

Having traced the entrance, course, and exit of the various types, let us follow the sac reversely; that is, from without inward in the combined type as described in case here reported and note the structures through which it passes. Covering the knuckle of bowel and bladder, from without inward, we have the skin and mucosa and peritoneum only. The structures penetrated from without inward are, the anterior layer of the triangular ligament, posterior layer of the triangular ligament, ischiorectal fascia, levator and rectovesical fascia. In the direct or anterior variety the structures penetrated by the sac and the coverings of the sac are the same as in the posterior variety, except that peritoneum only partly forms the sac and the hernia is of the para-peritoneal type. A clear understanding of these anatomical relations is necessary for a successful repair of this type of hernia.

Mechanism of occurrence. The long pelvic loop of the sigmoid fixed only at its junction with the fixed rectal portion of the gut at the end of the mesentery (opposite the third sacral vertebra) "knuckles" at this fixed point after slipping down along the posterior surface of the broad ligament. At the site of this kinking (rectosigmoidal junction) is the weak spot of the pelvic diaphragm above (Fig. 1). In this angulated position the gut "slides" *en masse* forward and downward pouching the peritoneum ahead of it, tearing through fascia, levator, etc., thus forming always the "sliding" type of hernia. The kinking and partial obstruction at the rectosigmoidal junction explains the rectal symptoms and their intermittent character.

ETIOLOGY

Primarily, of course, all of the factors bearing on the etiology of all herniæ must be considered. Von Winckel in his discussion of pudendal hernia says that they are congenital or acquired. Pregnancy and parturition are the factors of most import and we find that the largest majority began during labor or were noted soon after. Difficult and instrumental cases are noted and emphasized in the majority of cases. This was true of my case. It is evident that trauma is a direct and activating factor. Age naturally would fall during the child-bearing period. The youngest is Cooper's case, 22 years old, and the oldest is 51 years, von Winckel's case. Not a single verified case is reported in the male. Von Winckel, in discussing this point, refers to a male infant, age 6 weeks, who had a protrusion through the sacrum opposite the second spinus process, the size of a walnut, which bulged and increased in size on coughing and straining and which underwent spontaneous cure as the bone developed and the opening closed. However, this case has been excluded by most authors as not a true pudendal hernia and was probably a meningocele on the basis

of spina bifida, and was so considered by Moschcowitz in his admirable paper. Von Winckel also mentions in the same article case of a male child, age 7 days, who presented along the left side of the pubis near the scrotum, a mass the size of a pigeon egg which was reducible. The description is too meagre and indefinite to be included as a proven case of pudendal hernia. (If these two cases could be verified and accepted they would be the only two cases in the male on record, and the only two spontaneous cases recorded.)

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Pudendal hernia should offer no great difficulty in diagnosis. There are certain essential features which make it certain of recognition. The most important are: First, the hernia always appears in the posterior part of the labium majus. It cannot appear elsewhere and also come through the subpubic triangle. Second, the mesial half of the protrusion is covered with mucous membrane and the other half with integument. Third, associated with these two features are all the ordinary signs of hernia: impulse on coughing, reducibility, etc. A consideration of the three points mentioned above will easily differentiate pudendal from the other forms of herniæ—inguinal, femoral, etc. and from bartholinian abscess. Rectocele or cystocele can never be confounded with this type of hernia.

TREATMENT

In spite of the fact that only one pudendal hernia has been reported cured (my case here reported being too recent to speak of as cured), we feel that a better understanding of the anatomy of this condition and the classification into three types, as a practical basis for operation, will lead to a more hopeful outlook. A consideration of the anatomy as exemplified in cadaver dissection and in the pictures herewith presented will, we believe, bear this out.

The anatomy is easily understood and the principles necessary to the successful cure of all herniæ are here applicable; namely, high ligation and excision of the sac and closure of the ring. This is particularly true of the posterior and combined types in which there is a definite sac. The anterior variety, with greater destruction of the levator and fascia, especially where large areas of these structures are ruthlessly torn away by forceps operation, the problem presents infinitely greater difficulties. Even here, where ligation and removal of the sac is impossible, and the problem resolves itself into closure of the ring, an exact understanding of the anatomy and a repair based on a knowledge of the structures involved, is necessary. In these extreme cases we would suggest a transplantation of the iliac fascia with pedicled flap held between the transplanted pedicled round ligaments for closing the defect above, together with a pedicled fascial transplant of fascia lata to plug the subpubic triangle below.

CONCLUSIONS

While it is obvious that no conclusions can be drawn from one case, nevertheless from a study of the 13 cases reported, the anatomy as shown in my case and in cadaver dissections studied, we feel that we are justified in making the following deductions:

1. Pudendal hernia, although extremely rare, should be easily recognized (three points).
2. All cases should be divided into anterior, posterior, or combined types as the basis of operation.
3. Every case should be submitted to operation.
4. A knowledge of the anatomy, the type presented and application of the principles of the operative treatment of all herniæ should result in a cure in a large majority of cases.

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NATURE AND SIGNIFICANCE OF RENAL STASIS

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MY interest in renal stasis aside from the operative treatment of hydronephrosis has been incited through the study of persistent colon bacillus infections. Preliminary report on this work has already been published (Crabtree and Sheddon, 1). In the course of these investigations I came to recognize that small degrees of stasis in the kidney existed, often associated with pain and very commonly associated with persistent infections. Further observations on pyelitis in pregnancy and stasis from renal abnormalities, together with investigations of cases of abdominal pain encountered in the Out Patient Department of the Massachusetts General Hospital and my own office work have convinced me that considerations of renal stasis from the physiological rather than the pathological point of view might add knowledge which would have bearing on the treatment of these conditions. I mean by that, determination whether the kidney is hampered in elimination of urine from the pelvis rather than whether a dilatation sufficient to term hydronephrosis exists.

Heretofore classifications and, so far as I am able to determine from the literature, treatment also has been based on the pathological picture presented first of all by autopsy and surgical specimen, later by the pyelogram. Attempts have been made by the urologist and the roentgenologist to determine from the appearance of the pyelogram almost entirely to the exclusion of data which is obtainable by use of the cystoscope and ureteral catheter as to whether or not a kidney is pathological. This I believe to be erroneous. As a result of this conception beginning dilatations and small degrees of change are often overlooked at a time when remedia measures could best be applied. Likewise because of incomplete knowledge of greater degrees of dilatation which are temporary in nature, unnecessary destructive operations have been done. A recent classification of hydronephrosis bears evidence to this contention. In fact this classification seems to me to be based entirely on size of the pelvis as shown by pyelogram. By it hydronephroses are divided into

1. Early hydronephrosis;
2. Moderate hydronephrosis;
3. Large hydronephrosis.

To be sure the relation between infection, mechanical obstruction and disturbance of innervation are discussed. Such a classification, however, misses many of the important points on which therapeusis must depend. These classifications are analogous to classifying into large bears, bears and little bears. Any hunter will recognize that it is more fun to shoot the big bear. Consequently large hydronephroses have received more consideration at the hands of the surgeon and occupy a larger place in the literature of the subject. Yet these must have had beginnings and be results of factors which have been operating a long time past to produce the condition encountered.

I believe that four types of renal stasis ought to be recognized to exist between the normal kidney and the large hydronephrosis. These are

1. Acute stasis;
2. Subacute stasis;
3. Intermittent stasis;
4. That condition known for want of better names as relative stasis, atonic dilatation (Braasch), idiopathic dilatation (Bard), and potential obstruction (Robinson); terms applied to the occasional case of reno-ureteral dilatation without obvious cause. It will be recognized that the above classification is based on the physiology of elimination of urine from the kidney rather than the degree of pathology produced.

DEFINITION OF TERMS

In order to indicate what is meant in this discussion by the terms "pelvic content" and "pelvic capacity" in the observations recorded, I will define the two.

Pelvic content is the amount of urine present in the pelvis at the time a plugged catheter is inserted into the pelvis. After inserting the catheter the plug is removed and a syringe attached. With the bladder empty to provide against suction of fluid up the ureter from the bladder, if such reflux is ever possible, all the urine that will flow freely and steadily into the syringe is withdrawn and measured. This is taken to indicate the pelvic content.

Pelvic capacity is measured by the amount of fluid which can be injected into the pelvis sufficient to produce pain *and withdrawn*. The amount withdrawn and not the amount injected represents the capacity.

THE NORMAL KIDNEY

Clinical observation substantiated by animal research has given us some definite facts regarding the secretion of urine. Variations in the renal pelvis make it impossible to state a figure which accurately represents a normal capacity for the renal pelvis. Pelvic capacity seems susceptible of wide interpretation. Fenwick considered 2 ounces the upper limit of normal capacity, Kelly and others, 3 drams. Seres finds the average pelvic capacity in the normal to be 6 to 7 cubic centimeters, average postmortem distensibility 15 cubic centimeters. This is a fair estimate of the average established by most clinical workers. I have found that it is seldom that a normal pelvis can be distended to more than 10 cubic centimeters, and use that as a working basis. The great majority of normal pelves will not allow that degree of distention. It must not be forgotten that in certain instances in which there is congenital inequality of distribution of kidney tissue the congenitally large normal kidney may have a pelvic capacity in excess of 10 cubic centimeters, and yet be free from any evidence of abnormalities in outline. Even though the average capacity of the pelvis is in the neighborhood of 6 to 7 cubic centimeters, during excretion, it is not full to capacity. Seldom does one find more than 2 to 3 cubic centimeters of urine in the pelvis of the normal secreting kidney. Peristaltic muscular movements beginning in the pelvis but more pronounced in the funnel portion near the pelvo-ureteral junction force small amounts of urine into the ureter. Successions of peristaltic waves carry these small quantities of urine down the ureter, from which they are ejected into the bladder in small jets. Fluoroscopic demonstration, while not entirely satisfactory, has given some evidence on this subject, but series of plates taken at short intervals after injecting the pelvis with opaque solution have made this muscular movement evident. A pelvis completely filled with thorium or sodium bromide solution will empty itself completely in from 6 to 7 minutes. Overdistention of the pelvis to the point of producing pain is associated with or followed by increased peristalsis of the pelvis and the ureter. It is also recognized by urologists that in the larger hydronephrotic pelves overdistention is either painless or produces only a dull ache and is not accompanied by cramp-like pains as in the normal kidney. Seldom are peristalses seen in these pelves. The degree of relaxation and fibrosis of the pelvis and loss of contractility is, of course, the reason for this phenomenon.

For the sake of clearness in the consideration of stasis, I wish to adopt the point of view taken by Gardner (F. E. Gardner, 2) and exclude the large renal dilatations in which destruction of the kidney has already taken place. These complicate the picture because they are end-results in which the etiological factor has already done its work and is often not easily recognizable. "Let us put aside all cases in which the urinary distention though localized to the upper urinary tract is only an epi-phenomenon in the evolution of an altogether different disease." This, of course, excludes hydronephrosis due to pelvic tumors such as carcinoma of the uterus, prostate, vagina, and rectum; fibroid growths, procidentia, ovarian cysts; tuberculosis, adenitis and bladder and urethral obstructions. I also wish to exclude those large end-result renal dilatations in which it is difficult to state the factors which have operated to produce the dilatation and renal destruction. It is usually impossible from the history or pathology

to unravel the factors which have operated to produce these conditions. They are conditions already beyond hope of remedy. "Any large easily felt hydronephrosis is the evidence of failure; any large easily felt pyonephrosis is the evidence of culpable neglect—both might have been avoided" (E. H. Fenwick, 3). After this limitation of the subject I shall now proceed to discuss the four classes of stasis previously mentioned as existing between the normal kidney and the large hydronephrosis.

ACUTE STASIS

Acute stasis is, I believe, almost entirely emergency. It occurs most commonly with stone but is seen in accidental ligation of ureters, plugging of the ureter and pelvis by blood clot, and some degree of acute stasis has been shown to exist during acute attacks of pyelonephrosis, due to swelling of the ureteral mucosa, particularly at the ureteropelvic junction. I have found some degree of stasis in most cases in which cystoscopy was done during the acute stage of colon bacillus pyelonephritis. In most instances the cause of acute stasis is easily and early removed. Older experimental work by Cohnheim and Alberran showed that obstructing the ureter produces sudden rise in pelvic pressure in the kidney which often reaches 73 millimeters in an hour. Sudden complete obstruction, however, paralyzes the secreting power of the kidney which is reasonably soon destroyed before time has elapsed sufficient to allow dilatation of the pelvis. When these kidneys are cut down upon, a small tense pelvis is found with almost stony hardness of the kidney and a tense dilated ureter of somewhere between twice and three times the normal size extending down to the point of obstruction. When pyelotomy is done, even though 4 or 5 days have elapsed since the obstruction intervened, there is a violent gush of urine and almost immediately the kidney takes up its function of secreting. The polyuria which follows relief of obstruction immediately sets in, continues for 24 to 48 hours, after which the urine becomes more concentrated and the flow more nearly normal. I have not seen acute complete obstruction for a period exceeding 4½ days, but have frequently seen cases from 2 to 3 days after complete obstruction. These latter cases were due to stone, in all except one instance in which, following an injury, the kidney and ureter became distended with blood clot, completely stopping secretion. This was of 3 days' duration. In one instance I have seen both ureters tied into the stump of the uterus at hysterectomy and completely obstructed so that no urine whatever was passed for 4½ days. I did bilateral pyelotomy, later dilating the ureters through the bladder after the ligatures had softened. In this instance both pelves returned to normal capacity. The same was true of the case of hæmorrhage into the pelvis and ureter after I did pyelotomy for drainage. In the cases of stone the pelves were all small, yet it is impossible to state in stone cases whether dilatation may not have been produced by the presence of the stone in the pelvis before the acute obstruction took place. Bradford found in animal experimentation that after complete obstruction of the ureter the kidney would return to its normal form if obstruction was removed after from 10 to 40 days. It is my belief that acute obstruction even though complete, when encountered clinically, is not serious in its after effects and we may expect the kidney to return entirely to its normal condition when the obstruction is removed.

SUBACUTE STASIS

By subacute stasis I refer to those cases of partial obstruction with back pressure and overdilatation of the kidney, which is of weeks' or months' duration. The outstanding class of cases in this group is the back pressure kidney associated with pregnancy. Since Rayer in 1841 remarked the difference between ordinary pyelitis and the pyelitis of pregnancy, it has been recognized that there is hydronephrosis developed with or without pyelonephritis symptoms during the period of gestation. Stasis of this type I have frequently found in the absence of pyelitis, although usually not to so marked a degree as in the presence of infection. This subacute type of obstruction is, however, easiest

studied in pregnant women because of the known duration of the obstruction, which of necessity cannot exceed 9 months, and the complete removal of the obstruction suddenly at the termination of pregnancy. It is not uncommon to find pelvic dilatation of from 30 to 480 cubic centimeters in this type of case, often in patients whose symptoms have persisted only during the last months of pregnancy. Caulk calls attention to the readiness with which some of these cases are improved by cystoscopic treatment (Caulk, 4). However, he has produced no evidence to show what was the end-result to the kidney at the termination of pregnancy.

Braasch in discussion denied the existence of large hydronephroses occurring during pregnancy. This last statement I believe to be erroneous because my experience with these cases (which will be published later) has shown the frequent occurrence of dilatation ranging from 30 to 480 cubic centimeters. They are usually in excess of 200 cubic centimeters. In this connection it is important to recall Perinæus' three grades of renal retention. These are dependent on the amount of distention and the damage to the elastic tissue in the walls of the pelvis and ureter.

1. Retention of small quantities of urine. This urine is under pressure from the elasticity of the pelvic wall, the tissue of the pelvic walls are under tension but have not lost their tone.

2. More pronounced dilatation, fibrous tissue is weakened but has not completely lost its tone.

3. The kidney is damaged, fibers are overstretched and incapable of returning to their normal. The renal function in these kidneys is greatly impaired.

This classification, of course, does not apply except in part to the subacute stasis under discussion. It does not apply because even though the overdilatation of the pelvis is extreme it has not existed long enough to produce flattening and thinning of the cortex but approximates a purely pelvic change. It does apply, however, in that the retention of small quantities of urine seems not quickly to influence the pelvis and that greater dilatation is possible without complete loss of the elasticity of the pelvis, and third, that in overdilatation some degree of permanent pelvic damage seems to be constant. I have evidence to show that in these pregnant women in whom stases of 200 to 300 cubic centimeters has decreased to 15 cubic centimeters at the termination of pregnancy, instead of remaining at the latter degree of dilatation, the pelvis may simply by the process of the disease, undergo further dilatation in succeeding years without the intervention of subsequent pregnancies. In other words, small degrees of permanent damage in the presence of infection may progress toward pyonephrosis.

Mrs. F. R. M., Jr., 2 pregnancies, first 4 years ago, second 1 year ago. During the first pregnancy patient had pruritis for several months from urinary incontinence. During puerperium she had fever and pyuria. During and after the second pregnancy she had incontinence for 3 months and some slight degree of bladder irritability. The incontinence was worse on walking, coughing, or sneezing. Catheter urine examined once since birth of last baby 7 months after delivery and found to contain much pus.

At certain times, particularly when tired, she has much frequency and some burning micturition. She is comfortable only when taking hexal, which she has taken most of the time for 4 years.

The right kidney is low, descending to the crest of the ilium. The left kidney cannot be felt. These observations are corroborated by X-ray.

Cystoscopy showed slight redness of the bladder mucosa. This was not marked. There was a dull œdematous-looking trigone.

Both urines were cloudy and contained a small amount of clumped pus and a few bacilli which in culture proved to be bacillus coli. Functional test (phthalein) showed a decreased output from the right. Right kidney 10 per cent, left 20 per cent. Both pelves were found under 12 cubic centimeter capacity.

This examination was made in October, 1920. The patient remained entirely comfortable on 20 grains of hexal a day until January 5, 1921, when she began to have increased discomfort and more marked pyuria. These symptoms have continued since.

Pyelograms taken in November, 1920, show "The shadows of the injected pelves normal in size and shape; the calyces small and somewhat irregular but the cupping is present."

Cystoscopy, March 24, 1921, showed no particular change from the findings of October of the preceding year, except that repeated estimations of the pelvic capacity (made with the bladder empty)

showed the renal pelves to have increased in capacity; the right to 20 cubic centimeters, and the left to 25 cubic centimeters.

It is to be noted that the right kidney shows ptosis, the left none, yet the left is the greater dilatation. There is no other apparent reason for the change in the size of the infected pelves than the pyelitis and the occurrence of attacks of pyelonephritis which occasionally intervene. Yet appreciable damage to the kidneys has taken place in a reasonably short space of time.

Another type of subacute obstruction, perhaps equally frequent if not more so than the pyelitis of pregnancy, is the slowly progressing and partially obstructing ureteral stone. In those instances in which I have been able to pass a catheter by a stone which was known to have been present in the ureter for several months, I have been able to determine ureteral and pelvic dilatation which exceeded by several times the capacity of that same kidney after the stone had been removed. Even small stones which are not sufficiently large completely to obstruct the ureter and are known to be rapidly passing down, the passage of a catheter into the pelvis of the kidney shows a fair degree of stasis even in the intervals between attacks. Undoubtedly, obstruction here is not complete, yet the swelling of the mucosa of the ureter together with the stone definitely embarrasses the drainage on that side. Where this condition exists for many months, permanent damage may result. The problem for the urologist is to determine, if it is possible to determine that fact, something of the time element required in these cases to produce permanent damage, and to see that these stones are removed within a safe interval. I suspect that time sufficient to produce damage in one kidney may fail to produce it in another. No doubt also subacute stasis in the kidney is frequently encountered in those cases of prostatic obstruction which are of rather sudden onset and of relatively short duration. However, the point which I wish to emphasize is that by recognizing subacute stasis as an entity, the kidney may, by early intervention, be spared even small degrees of damage. I wish to present the data of a case of pyelitis of pregnancy in which some idea of the date and degree of return to normal has been determined.

Patient seen at the Lying In Hospital in September, 1921, in the seventh month of her pregnancy. There had been no symptoms referable to the urinary tract at any time preceding this, her first pregnancy. The attack was ushered in by fever, chills, and the usual symptoms of pyelonephritis. She had spent from the second to the seventh month in bed because of the pyelitis symptoms. When she entered the hospital the right kidney could be palpated as a large soft mass, even though its outlines were obscured to some extent by 7 months' uterine tumor. The left kidney was indistinctly felt and was considerably smaller. Examination made immediately before the first cystoscopy showed that the cervix was beginning to dilate. Right ureter orifice could be seen but not catheterized. The left ureter was catheterized and was found distended with 280 cubic centimeters of infected urine. Following miscarriage the temperature dropped to normal and remained so for 6 days. The urine continued pale but contained considerable pus. At the end of 6 days, patient was again cystoscoped on account of rising temperature and 108 cubic centimeters of very thick greenish-yellow pus withdrawn. Under ordinary circumstances this condition would certainly have been considered a pyonephrosis suitable for nephrectomy. After emptying the pelvis the pelvis was washed until fairly clean with 1–500 silver nitrate. The left kidney contained 30 cubic centimeters of cloudy urine. When dilated with boric solution above that capacity, pain was produced. Several determinations showed 30 cubic centimeters to represent the capacity of the left kidney, which 6 days before had been dilated to 280 cubic centimeters. Patient was cystoscoped again 6 days later (that is, 12 days after delivery). Both urines were cloudy, the right pelvic capacity was 26 cubic centimeters, the left 16 cubic centimeters. December 1, patient was again examined (about 2 months from the date of delivery), the right pelvis showing 15 cubic centimeters capacity, the left one 12 cubic centimeters. Patient reported by letter March 17, 1922, that her urine was still purulent but the kidneys were giving no pain.

Similar cases, yet not quite so striking since pyonephrosis did not develop after delivery, have shown that the pelvis returned to somewhere near normal capacity only to have repeated attacks of pyelonephritis develop and subsequent cystoscopic examination demonstrate gradually increasing pelvic capacities. Whether this increase is due to relaxation of the pelvic walls by infection or whether the dilatation is the result of in-

creased residual during the attacks of pyelonephritis cannot be determined. That these pelves are capable of progressing toward pyonephrosis seems to me to be definitely indicated. Subsequent investigation of this group of cases will determine that fact. The recognition of this and similar sequences of events are significant in the handling of the patients with pyelitis of pregnancy. The bearing of these observations on other types of subacute stasis is apparent.

INTERMITTENT STASIS

Intermittent stasis is in part the question of the floating kidney. Keen considers the movable kidney next to pelvic tumor the chief cause of renal dilatation. The literature of ptosis and particularly of renal ptosis is voluminous. It is chiefly the literature of the past decade which saw the development of fixation and the change in sentiment against the indiscriminate fixation of movable kidneys. The development of the pyelogram which makes possible detail study of this group of cases, now allows us to review from a new standpoint much valuable literature on the subject.

There are other conditions besides renal mobility which may give rise to temporary renal obstruction of an intermittent nature. Supernumerary vessels should, I believe, be classed as one of these. Renal mobility is probably intimately associated with aberrant arteries in all cases in which pelvic stasis results. For this reason the two conditions must be considered together.

The frequency with which renal mobility is encountered both as regards age and sex is fairly well established. Kuester, in a survey of normal individuals, found renal mobility in 1 to 207 men, 1 in 22 women. Hahn, in 100 women, found renal mobility in 5.5 per cent. In 50 children, including equal numbers of males and females, he found but 1 movable kidney. He found the right kidney movable 15 times as frequently as the left. Landeau found both kidneys involved in 5 per cent of all cases in which there was renal mobility. Skorchewski found floating kidneys in 2.2 per cent of all individuals examined. Lancereaux found floating kidney in a proportion of 55 women to 5 men and four times as often on the right side as on the left.

"By and large, nephroptosis is encountered clinically in three classes of cases: (1) without symptoms, (2) without symptoms directly referable to the kidney, (3) with symptoms referable to the kidney" (Keyes). Keyes' statement is distinctly a statement of the facts, particularly if we conceive the first group to be disproportionally large. In other words the great majority of palpable kidneys are functioning normally in spite of some degree of mobility; yet the preponderance of pyonephrosis, hydronephrosis, persistent pyelitis and renal pain in the right side as compared with the left, in the female as compared with the male, and in the adult as compared with the child, points to some degree of significance in these anatomical differences. It also indicated that renal damage is a progressive condition, i.e. has small beginnings.

The time-honored classification of movable kidneys into congenital and acquired mobility must be remembered. It is probable that we must revise our view regarding the numbers in the first group. Morris' statement that "a floating kidney with a mesonephron is, of course, always congenital" is a fact. Such cases are rare. Their very existence has been denied by Alberran. Gardner has pointed out that congenital defects in the development of the ureter may play a rôle in these low movable kidneys in the production of stasis (Gardner, 5). He adopts Pasteau's classification of renal mobility, which is:

1. True ectopic kidney in which the renal vessels take origin low down on the aorta or from the common iliac.

2. The origin of the vessels is slightly below the normal position, the kidney pedicle is long, the kidney can be replaced into its fossa.

3. The origin of the vessels is normal, but the pedicle is long, the kidney is freely movable but remains vertical.

4. The origin of the vessels is normal, the pedicle is short, the kidney on descending assumes an oblique position. This last is the typical acquired mobility.

Certain congenital ureteral conditions may

play an important part in the development of stasis not only in the normal kidney but particularly in the movable kidney. These congenital factors are: (1) developmental rotation of the kidney, (2) fœtal valvules. These factors are more common in the upper segment of the ureter but are also occasionally found near the bladder. Wolffer in 100 newborns found more less transverse folds in the mucosa near the pelvo-ureteral junction. In ten instances the outlet of the pelvis into the ureter was very much narrowed, scarcely admitting a filiform. In the fœtus these are constant findings (English). Not only are there spiral folds in the mucous membrane of the upper portions of the ureter but also striations on the outer coatings which are in evidence of the rotation of the kidney during development. After birth these normally disappear due to the eccentric pressure of the urine and growth of the ureter. They disappear from the lower segments upward, and are most apt to persist in the upper ureter near the pelvo-ureteral junction. Arrest of development may mean the persistence of these abnormalities into adult life. In the normal kidney they may be insufficient to cause stasis, but in movable kidneys they are operative.

It must also be remembered that the ureter is loosely adherent to the peritoneum throughout the greater portion of its course from the brim of the pelvis upward toward the kidney. About 3 centimeters from the pelvis the ureter leaves its close relation to the peritoneum and passes through the perinephric fat to join the pelvis. This is known as the mobile portion of the ureter. Not only is it the point at which fœtal abnormalities are most apt to exist but it is the point at which kinking of the ureter in movable kidneys is apt to take place. Kinking implies fixation of the ureter at the point of kinking. Kinking without ureteral abnormalities may and clinically seems to be unattended by evidence of stasis in many instances. In still other instances unusual thickness of the bands of fibrous tissue which normally bind the ureter loosely to the peritoneum at this point have been found to be sufficient cause for hooking up the ureter in this movable portion of its course. Frequently anomalies in caliber are found in the ureter at this place. I have usually found that the caliber of the ureter was not decreased and the apparent narrowness was merely angulation. Angulation of the ureter in this area has been much more frequently due to fibrous bands than to any other cause.

Supernumerary vessels are encountered in some instances without the appearance of having produced any obstruction to the outflow of pelvic urine. Boogard, in 1857, observed the first case of obstruction from aberrant vessels. English states that a vessel in front of the ureter cannot cause hydronephrosis. Kuester, Israel, Bazy, Duval, and Gregoire concur. They even reject the rôle of vessels in producing renal retention. Roberts, Morris and Decressac take the other extreme and contend that all hydronephroses which develop in kidneys showing abnormal blood distribution are due to vessel defects. Fenwick claims that 16 per cent of primary pelvic dilatation is due to aberrant vessels. The facts of the matter seem to be that about one out of four aberrant vessels passes behind the ureter and that a vessel in front of the ureter is not able to produce obstruction in a movable kidney. Veins seem to be incompetent to obstruct the ureter. The frequency of occurrence and the nature of arterial subdivision is well demonstrated by Eisendrath (6).

Since Landeau's papers and the work of Terrier and Baudouin it is generally believed that movable kidneys cause a type of hydronephrosis or stasis called intermittent. As a rule the movable kidney with well-marked symptoms of intermittency is not associated with large pelvic dilatation. The reason for this seems to me apparent; first of all because the stasis is not persistent throughout the 24 hours period. Stasis is produced when the patient is in the upright position and relieved in the resting, prone position. It has been estimated by animal experimentation that considerable permanency to the obstruction must be provided before rapid or extensive dilatation takes place. This, however, does not militate against these kidneys being painful, representing actual temporary stasis

and showing progressive, even if extremely slow, dilatation. I have been able to demonstrate in one instance a change in pelvic capacity from 7 cubic centimeters to 14 cubic centimeters within a year's time. During this time symptoms had been present and pyelogram showed definitely the difference in size of the pelvis at the two examinations.

I have also remarked that frequent cystoscopic examinations of the same patient will show evidences of considerable overdistention of the pelvis at the time of renal distress. In one individual the capacity of the right pelvis on two examinations was not in excess of 7 cubic centimeters. On two other occasions when the patient came to my office late in the afternoon after a day of activity in shopping, the same pelvis was found to contain 15 cubic centimeters of fluid at the time a plugged catheter was inserted into it. After this quantity of urine had been aspirated off through a syringe, distention of the pelvis to 7 cubic centimeters again produced pain. It was not possible to distend the pelvis to 15 cubic centimeters. In this instance definite overdistention of the pelvis on two occasions when symptoms were present was established. Symptoms of intermittency (Dietl's crisis) was the chief complaint. The parallelism between urinary intermittency and renal mobility is not the less real because of certain discrepancies. It is not uncommon to find a patient who although she has frequently passed urine during an attack of renal pain, passes from 1 to 2 quarts of urine in the succeeding 2 hours after the pain ceases. A close parallelism would demand that this patient have an extremely large hydronephrosis which suddenly empties itself with relief of the pain. Such is not the case. Patients with marked symptoms of intermittency have usually had small pelves.

A large hydronephrosis with overdistended walls has lost its muscular elasticity to such an extent that it is unable to empty itself even when the obstruction is removed. This is apparent to those surgeons who have attempted to cure large hydronephroses by reimplanting the ureter or doing plastic operations on the pelvo-ureteral outlet. Such kidneys do not return to normal size. In most instances where symptoms of intermittency occur, pyelogram will demonstrate that the kidney which has given pain and where a polyuria follows cessation of the attack, is not greatly, if at all, dilated. I have recently had a patient whom I observed during a typical "Dietl's crisis" of an hour's duration accompanied by frequent attempts at urination during the attack. Cessation of pain was followed by polyuria. The patient passed about 2 quarts of urine in the succeeding 2 hours. Pyelogram showed a slightly bulging kidney with a kinked ureter. Cystoscopic determination of the pelvic capacity showed that the dilatation was not in excess of 10 cubic centimeters. This was a left-sided, congenitally movable kidney. "Dietl's crises" are more apt to occur in the small not overdistended pelvis in which the tone of the musculature and pelvic contractility is not lost. Such kidneys are still sensitive to distention. A parallelism is that of the painful, spreading inguinal ring during the development of a hernia. After the dilatation of the ring has been accomplished, the pain becomes less severe if it does not cease altogether. On the basis of the above argument I have done suspensions of the kidney and plastic operation for the relief of renal pain and for the cure of persistent pyelitis where small degrees of stasis existed. The operations have given uniformly satisfactory results. I believe these small degrees of renal stasis in which a small pelvis is distended to *its* capacity, are just as definite instances of renal stasis as where a large hydronephrotic sac is distended to its capacity. I recognize that suspension operations are in disfavor and to a great extent in merited disfavor. I believe it to be unsound surgery to do operative interference on a kidney either because its position is low or because the course of its ureter is not straight. I believe it to be *absolutely essential* to demonstrate the existence of stasis by means of the cystoscope and the ureteral catheter. This can only be done after cystoscopic study with several observations. I recognize that the rate of change in these early obstructions is slow because

of the intermittency of that obstruction. I plan to report on these cases only after sufficient time has elapsed to allow of determination of the permanency of results. The oldest of my cases are of but 3 years' duration. All have been relieved. Even though the relief may not be permanent, which I doubt, the operation has been justified. The maintaining of a comfortable, properly functioning kidney for that length of time is worth the price. Blind standard operations have no place in the treatment of these kidneys. Suspensions must be done with a view to remedying the defect present in that particular kidney as shown by pyelogram.

I have some evidence to show on cases which have been observed over a period of years that slow dilatation takes place. The longest one of these instances has been that of a man with bilateral small renal stasis seen in the hospital in 1913 and followed until the present time. His pelvic capacity on both sides has increased three times what it was at the first observation in a period of 9 years.

The part which ureteritis and peri-ureteritis play in producing small degrees of temporary partial obstruction must be recognized, but as yet sufficient data have not been accumulated to allow definite statements as to the importance of this condition.

It should also be mentioned that there are those who believe that the bouts of passing urine in large quantity such as takes place in intermittency have in themselves the effect of producing increased pelvic capacity (Fenwick). The thinned ureters, pelves and bladders and increased capacity of these organs in diabetes insipidus is cited.

My purpose in calling attention in such detail to intermittent stasis is that I believe it to be a large group of cases the nature of which is in great measure misunderstood and that the end-results both as regards persistent infection and pelvic dilatation are not well known. This error is chiefly due to failure to recognize the slow rate at which change takes place and the rare circumstance that allows one observer to follow a case from its inception to the final outcome, either in destruction of the kidney or in death of the patient. Most of the attacks of pain are not severe enough, nor is the succeeding polyuria sufficient in quantity to attract attention. Yet careful observation has led me to believe that the painful kidney is a "Dietl's crisis" in miniature and the same factors operate even though the symptoms are moderate.

Fenwick has called attention to the fact that serious degrees of pelvic dilatation can take place in the absence of any symptoms in the patient's history which can be interpreted as representing a stage of painful dilatation. He believes that these kidneys are of decreased sensation. Only on this assumption can the facts of clinical experience be correlated. There is no other way in which we can explain the frequent findings of definite hydronephrotic sacs of considerable capacity either by accident or because of the presence of pyuria.

RELATIVE OBSTRUCTION

By this term I wish to refer to the group of cases in which there is no apparent obstruction to the outflow of urine from the renal pelvis, ureter or bladder, or if stricture exists the dilatation continues below the point of obstruction as well as exists above it. This type of pelvis and ureter are occasionally found in bilateral pyelogram on the side opposite to definite pathology. The condition has apparently existed without symptoms. In some instances the kidney is low. In other instances it is up in normal position and does not descend in such a way as to obstruct its ureter. The dilatation often continues through the bladder wall involving the sub-mucous portion of the ureter. The nature of this obstruction and the cause of it do not seem apparent. These kidneys usually function well. The cortex is often not at all thinned in such a way as to indicate any serious degree of back pressure. There are few, if any, symptoms connected with the condition if infection is absent. When infected they are extremely troublesome and do not yield readily to any kind of treatment. The ureterovesical valve is often incompetent and injection of fluid into bladder causes back-wash into kidney pelvis.

The etiology of these conditions is probably congenital. In fact the ureter is often irregular and may appear as a "spiral ureter." There is often congenital absence of the sphincteric valve at the lower end of the ureter and I have once seen the condition bilateral. Pathological examination of the walls of the ureter does not show any definite pathology of a causal nature. The coats are thinned and the muscle fibers are widely separated, as is found in any overdilated ureter. In one specimen removed at operation, there were a succession of mucous membrane shelves which were responsible for the spiral appearance of the ureter as seen in pyelogram. These may have been remnants of the valvules which are described in fœtal life. Valves, however, should have produced some degree of obstruction unless accompanied by congenitally thinned ureteral walls. The kidney did not show signs of any back pressure although the pelvis was greatly dilated. It has been suggested that the condition might be due to the drag of a large cæcum or sigmoid. Such did not exist. The close relation between these cases and the cases of congenital absence of the ureteral valve seems to me to point to a similar origin.

In those instances where there is a definite obstruction of the ureter in its upper or middle portion with dilatation above the point of obstruction and pyonephrosis, infection is a sufficient explanation of the dilatation below the point of obstruction.

In placing these four groups of stasis between the normal kidney and the large hydronephrosis, I am not attempting to complicate the picture without a reason. It is that I may call attention to stasis in contrast to hydronephrosis. I believe that future study will demonstrate that it is possible to recognize the *condition* without waiting for the *result*. To treat the result is necessarily less desirable and less productive of lasting benefits to the renal tissue which overlies the pelvis. The bearing of even small degrees of stasis on persistent infections is definite evidence that this point of view which I am endeavoring to present is worthy of consideration.

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THE QUESTION OF RECURRENT RENAL CALCULI[1]

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THERE is a disappointing scarcity of literature upon the important and interesting subject of recurrent renal calculi. In their excellent paper on this topic published in 1915, Cabot and Crabtree[2] remarked that they could "find no useful statistics bearing upon this important question." Since this date the literature contains but one article, that by Braasch, published in 1917.[3] It would, therefore, appear that the subject is unpopular either because of the long and patient labor which the accumulation of data involves, or because of the disappointing results which the investigation has revealed. Be that as it may, certain personal experiences led me to take up the question from a new point of view, and for the past year I have given it intensive study.

We are all familiar with the fact that during its residence in the kidney, a stone may give rise either to no subjective symptoms whatever, or to pain in such an unusual location that the diagnosis is not made without some delay. Furthermore, it is equally well known that in an appreciable number of patients the urine is persistently negative. For these reasons it is obvious that in order to say whether a patient has a renal calculus, he must be personally examined and have a careful roentgenographic examination of the urinary tract. The patient's statement by word or letter, and often even that of his doctor, is therefore not sufficient for the desired purposes. With this idea in mind, Cabot and Crabtree, in the article already referred to, based their conclusions only upon such cases as they were able to examine personally. There were 87 such cases, of which 63 had been operated upon for stone in the kidney, 21 for stone in the ureter. Thirty cases treated by nephrotomy showed a so-called "recurrence" of 56 per cent, while in 33 cases having a pyelotomy the figure was 51 per cent. Unfortunately, we do not know how many of these patients had had an X-ray during convalescence from or within a few weeks after operation. In the absence of this information it is impossible to say whether the stones found in a kidney a year or more after operation are actual recurrences or what may be called "left overs" from the operative procedure. My observations of the past year convince me that many of the cases would fall into the latter class.

Certain more recent investigations of my own show results which are equally unsatisfactory. Of 70 cases of nephrotomy, which includes all the operations of this type performed at the Massachusetts General Hospital from 1897 to date, the results are known in 35, either through personal communication, through the local physician, or by actual examination of the patient. Out of 16 who had a roentgenographic examination 14 showed the presence of stone in one or both sides, giving a percentage of 40 of those whose definite results were known. But here again the figures would be undoubtedly greater if all cases had been checked up by this procedure, and also many were unquestionably instances of stones left over after operation.

Of the cases of stone admitted to the genito-urinary service, 16 had been previously operated upon for renal calculus either at our hospital or elsewhere, and of this number 12, or 75 per cent, had had bilateral operations.

Furthermore, our records show that 10 patients had either passed a stone after pyelotomy or were found to have one in the kidney at the time of examination.

The situation is, therefore, serious enough to warrant careful investigation, in the belief that a more encouraging report may eventually be given. Such an investigation should not, however, be left to one man or to one clinic, but rather might advantageously be undertaken simultaneously by various observers and the collected data published.

Braasch's paper in 1917, gives a more promising view of the possibilities offered by

[2] Surg., Gynec. & Obst., 1915, xxi, 223.
[3] Surg., Gynec. & Obst., 1917, xxiv, 8.

[1] Read before the Section on Genito-Urinary Surgery, New York Academy of Medicine, April 19, 1922.

surgery for the relief of renal calculus. Of 88 patients re-examined, including roentgenography, only 13, or 14.7 per cent, showed recurrence. Here again no statement is forthcoming as to whether a roentgenogram during convalescence or shortly after was made in these cases, but the results are sufficiently brilliant in any event.

Upon inquiry, it seems to be clear that the custom of having postoperative roentgenographic examination of the urinary tract is not by any means a routine procedure. Such an examination is now the rule in our clinic and it is hoped that the statistics will eventually be not only more valuable, but more encouraging.

Upon investigating what has already been done in this direction, I found records of only 20 postoperative roentgenograms of the urinary tract, although I am aware that more than this number have been taken but not recorded. In 9, or 45 per cent, the roentgenogram showed stone still remaining in the kidney. In the absence of these postoperative roentgenograms, which clearly demonstrate my point about the frequency of overlooking stone during operation, these stones would be recorded as "recurrences" if found at a later date.

On first thought it is strange that the removal of stones from so comparatively small a cavity as the renal pelvis should be so uncertain a matter. It is even more remarkable that nephrotomy, "an operation which fully exposes the interior of the kidney to the eye and to the finger," should yield equally unsatisfactory results. But more careful consideration will show that the renal pelvis, although small, is actually a most complex cavity, with many ramifications in the form of calices, some with tiny orifices which may readily escape detection, an observation which may hold true even when the kidney is laid widely open by nephrotomy. In many kidneys the pelvis is practically bifid, the two portions connecting with one another by a long and narrow passage, the insertion of a probe into which is often a matter rather of luck than of skill. The more one studies the interior of the kidney, whether by pyelogram or by injection of fusible metal, the more one appreciates the difficulties which sometimes must be overcome in extracting a small stone from a distant cavity. For this reason, one cannot be too careful about the pre-operative diagnostic steps. It is not sufficient to know that a stone is in the kidney; one must determine exactly which calyx it is in, the relation of this calyx to the pelvis, and the character and position of its orifice. While careful routine pyelograms may suffice, a repetition of this procedure with the patient lying on the face instead of on the back, or even on the side, may prove to be a valuable aid. Whether injection of oxygen into the perirenal tissues or into the renal pelvis will prove to be of value remains to be seen.

While not by any means attempting to offer an excuse for the fact that so many stones are left in the kidney after operation, I believe it is important to realize that the remarks just made about the peculiarities in the shape of the interior of the kidney do not end the matter. There are many other difficulties to contend with.

In the first place it is all too frequently forgotten that while the X-ray may show one fairly large shadow, this may cover other smaller shadows lying in front of or behind it. At the operation a stone corresponding in size and shape to the roentgenographic shadow and showing no facets or signs of fracture may be easily extracted. The operator, satisfied with this, may then bring the operation to a close without further ado. On the other hand, he may conscientiously search for other stones but fail to find them. The causes of failure are numerous. In the first place, the manipulation required to extract the first stone, no matter how brief or gentle, and whether instrumental or digital, often produces considerable bleeding from the pelvic mucosa. If the remaining stone or stones be small they may become surrounded with fibrin to such an extent that the usual grating sensation elicited by a metal instrument is lacking and the stone is not detected. It is a not uncommon experience to wipe out innocent looking blood clot from the wound and find within it a small calculus wrapped in a dense layer of fibrin. In the presence of

such bleeding, the removal of stones of small size may be wellnigh impossible. I have tried to overcome this difficulty by the simple process of irrigating the interior of the kidney in an attempt to dislodge both clots and stones. An old fashioned silver catheter will serve well in most cases, and boric acid solution or sterile water can be forced through this with considerable pressure by the use of a hand syringe. In certain instances I have thus removed calculi which I was unable to find in any other way; in other cases a subsequent roentgenogram showed that this method is not wholly reliable. An experience with two or three cases of small multiple calculi scattered around in various portions of the kidney has convinced me that the successful handling of such a situation will tax all of one's skill and ingenuity and will often lead one to consider the advisability of nephrotomy or even of nephrectomy. At the same time, when one is handling a normal looking kidney, the urine from and the function of which is essentially normal, neither of these measures seems to be justifiable.

Another situation with which the surgeon may be confronted is that presented by the inaccessibility of the kidney, which in turn may be due to the extreme obesity of the patient, to the large size of the organ, to an undue shortness of the pedicle making delivery of the organ impossible, to the dense adhesions resulting from previous operation, or to a combination of these factors. To these difficulties I might add that which is encountered in a horseshoe kidney, where, owing to numerous large aberrant vessels, access to the interior of the organ is different or unsatisfactory. Under such circumstances I believe it may sometimes be quite impossible to remove a stone, or that in attempting to do so one may jeopardize the kidney or even the patient. Here again the question of deliberately taking out the kidney must be well considered, as if one fails to remove the stone, subsequent operation may be required. If the case is difficult to handle on the first occasion one can be very certain that it will present no easier a problem later on.

In a few instances where the stone has been too large to extract safely through a pyelotomy incision and where nephrotomy seemed unwise and nephrectomy unnecessary, I have yielded to the temptation to crush the stone *in situ* and remove it piecemeal. Entire success attended my efforts in one case; in two others the stone was easily crushed with a heavy clamp and apparently all the fragments removed. But as I think over these cases in retrospect, I believe that the few small fragments which were left behind became so covered with fibrin, owing to the free bleeding, that they could not be detected with a metal instrument.

It has been already pointed out that the attention to and the performance of certain details may turn failure into success. Even more careful pre-operative study, more painstaking search for other stones after removal of the first, avoidance of bleeding, and irrigation of the renal pelvis have all been mentioned. In addition to these measures there are two others which are sometimes of value. One is the old fashioned, but still useful method of "needling" the kidney. While this may be done with the eye-end of a large straight needle, I find that the rounded end of a small flexible silver or copper probe is far superior. Its bluntness is no bar to its insertion into the kidney cortex, and for this very reason it is safer than a more pointed instrument. Furthermore, it can be bent so as to go in any direction. Having a general idea of the location of the stone, one can insert the probe directly into the suspected calyx and finally elicit that welcome grating sensation which he has previously failed to get; or with an instrument in the pelvis grating against a stone which cannot be grasped, the localization of another surface of the stone with the probe will sometimes expedite its extraction by way of the cortex—in other words, by partial nephrotomy. I cannot emphasize too strongly the value of this method of approach to a stone under certain conditions. The pyelogram may or may not have demonstrated a dilated calyx, but unless the stone has remained entirely in the pelvis, such a thin walled calyx is pretty sure to exist. Its location may often be discovered with the probe, the insertion of which will show that its walls are very thin and may be widely

opened for the extraction of the stone. Small clamps are then inserted into the calyx, using the probe as a guide, and the stone grasped without difficulty. I have never found it necessary to suture the rent made in such a calyx, nor have I seen any untoward results either immediate or remote.

Finally I wish to speak of a procedure which, under certain circumstances, may be of indispensable value in the search for stones in difficult cases. I refer to the use of the fluoroscope, either by the surgeon himself, or by the roentgenologist during operation. This has been used in the Mayo Clinic for a considerable time and with very satisfactory results. In fact, I was recently told by one of the surgeons of St. Mary's Hospital that their reliance upon this means of locating stones was now so great that they could safely feel that every calculus had been removed if and when the roentgenologist reported that no more shadows could be seen in the kidney. Although I feel that this may be a somewhat optimistic view of the possibilities offered by this method of examination, it certainly shows that the technique has been brought to a high state of development.

While my experience with the fluoroscope has not been extensive, I have found it of tremendous value in certain cases. We have used a small portable machine and have had the fluoroscopic examination performed by our roentgenologist. He has taken pains to accustom his eyes to the light conditions by wearing dark glasses some time before his services were required. After delivering the kidney from the wound the X-ray apparatus is brought to a suitable distance from the patient's abdomen, a sterile sheet being draped over the tube. The roentgenologist arranges his fluoroscopic screen, also draped in a sterile sheet or towel, close to the patient's back. Stones of any considerable size may be readily seen; small calculi may require considerable search. Under the direction of the roentgenologist the surgeon is then able to touch or grasp the stone by means of a metal instrument inserted into the pelvis or into a calyx. Sometimes another instrument or even the surgeon's finger, outside of the kidney, acting in conjunction with that in the kidney, will hasten the location and the actual seizure of the stone with a clamp. In a few instances of multiple small calculi, stones which defied my every effort at localization, either because of their position or their coating of fibrin, have been successfully removed. In certain other cases, however, the roentgenologist, after careful search, has reported that no more calculi were to be seen. But subsequent roentgenogram has shown one or two small stones remaining, a fact which demonstrates that even the fluoroscope with a competent observer behind it is not infallible. I believe, however, that the roentgenologist must be especially trained in this particular type of case. It is comparatively easy to see the outline of a large mass of bismuth in the stomach or intestines, but it is a far more delicate matter to detect a faint shadow the size of perhaps a grain of rice in the kidney, and yet this is the very thing we would like to have located with accuracy. Another feature of fluoroscopy which is essential is that the kidney must be delivered entirely out of the wound, so that no other tissue intervenes between it and the tube or screen. The frequent impossibility of this is well known, so that one cannot tell until the time comes whether the radiologist can perform his part or not. If the kidney cannot be delivered from its bed, the overlying tissues both bony, muscular, and fatty will prevent a clear view of the organ. I believe it is possible that this difficulty may eventually be overcome and that this method of examination is capable of being developed into one of the most valuable at our disposal for the certain reclamation of every stone which the kidney contains.

From what has gone before we have seen that stones may be left in a kidney from which they were all supposedly removed with disappointing frequency, in spite of every means which one may adopt. It is therefore clear that a roentgenogram during convalescence is absolutely essential if one is to know the exact state of affairs before dismissing his patient as cured. The question now will be asked, What is to be done when this roentgenogram shows that one or more stones have been left behind? Should the patient be told

the facts and should a second operation be advised? With very few exceptions I believe it is highly desirable, and even necessary, that the patient should know the exact situation. If he is of average intelligence and if the relationship between himself and the surgeon is all that it should be, this information will be accepted in the proper spirit. If the situation is not made clear an attack of renal colic or the spontaneous passage of a stone shortly after the operation may easily lead to an embarrassing situation.

The question whether a second operation should be performed is one which should be looked at from various points of view. In the first place the patient may refuse, in which case the incident is closed, at least for the time being. If the patient is a poor risk or for any reason took unkindly to the first operation, one would hesitate to submit him to further risks. If a nephrotomy has been done and convalescence has gone on without the advent of secondary hæmorrhage the surgeon would, indeed, be bold to advise the tempting of Providence a second time. Furthermore, I believe, although I have seen no case to prove it, that the reopening of a previously nephrotomized kidney would very materially increase the amount of destruction to the organ which the first operation produced.

On the other hand, when the patient is agreeable to the proposition, if he is a good risk and stood the first operation well, if the kidney is not too inaccessible, and if the size, shape and position of the remaining stone or stones make the probability of subsequent spontaneous passage small, then I would advise a second operation. Having had occasion to so advise in several cases, I have performed the second operation 10 days or 2 weeks later. By this time the patient is well over the effects of anæsthesia, the possibility of infection is gone, and clots have become pretty well organized. On the other hand, adhesions are so delicate as to offer no hindrance to a rapid approach to the kidney and one's only difficulty lies in the increased thickening of the various structures from œdema and processes of repair.

My experience has been that the recovery of stones at the second operation is apt to be easier than was expected, and I have had only one case in which a roentgenogram after the second operation showed the presence of stone. This case has been followed carefully and the remaining stone has finally been spontaneously passed, aided meantime by the passage of a ureteral catheter on several occasions.

Before bringing this paper to a close I wish to say a few words on the choice of operation. Those cases which obviously require nephrectomy will not be considered. But since it has been shown that the number of stones subsequently found in a kidney, whether they are actual recurrences or "left overs" from a previous operation, is very high, and when one considers that this is true whether after pyelotomy or nephrotomy, the decision as to which operation to employ may be difficult. In a few cases the size and number of the stones or their position may leave one in no doubt that nephrotomy is the only possible procedure. On the other hand, when stones are so large or so numerous as to require this operation for their removal it will usually be found that the kidney is dilated beyond hope of recovery, that its urine is badly infected, and that its function as shown by the phthalein test is of little consequence. Under these conditions the kidney should be removed, for as W. J. Mayo[1] has remarked: "One of the most common causes of recurrence of stone has been the attempts to conserve a badly damaged kidney which was of little use functionally and a continuous menace to the future health of the patient."

Any series of nephrotomies will show a high percentage of disasters, fatal or otherwise. Among the 70 nephrotomies performed at the Massachusetts General Hospital from 1897 to date there was an operative mortality of 5.7 per cent, comprising 4 cases, of which 2 died as the result of secondary nephrectomy for hæmorrhage. Eleven of the series (15.7 per cent) had secondary hæmorrhage, requiring nephrectomy in 3 instances, while in 8 the bleeding ceased either after packing or spontaneously. Lest it be thought that our experience is unique, I find that Bevan[2] has

[1] Surg., Gynec. & Obst., 1917, xxiv.
[2] Surg. Clin., Chicago, 1918, ii.

had to do secondary nephrectomies in 8 or 10 cases within one or two weeks after nephrotomy, and that W. J. Mayo (loc. cit.) discussing 40 nephrotomies, says that "several had hæmorrhages after operation and in four it was necessary to do nephrectomy to save their lives."

The high percentage of recurrences after this operation, the very considerable chance of secondary hæmorrhage often requiring nephrectomy for its relief, and the undoubted fact that the kidney will be left in a seriously impaired condition, if indeed it was not so already, should make us stop and consider carefully whether it is advisable.

Turning to pyelotomy, we find a brighter picture. In the first place, the mortality is almost negligible. In one series of 206 cases at the Mayo Clinic, Braasch (loc. cit.) reports not a single death. In our clinic at the Massachusetts General Hospital we have lost but 2 patients after this operation in the past 11 years. Postoperative fistula of any considerable duration is rarely, if ever, seen, and it is hard to believe that the comparatively little disturbance of the renal cortex or of its blood supply results in further damage to the organ. Therefore, although the difficulties of removing stones from a kidney through a pyelotomy incision may tax the surgeon's uttermost skill and ingenuity, and although it has been seen that in spite of this effort the number of stones subsequently found is high, one should have no hesitation in selecting this as the operation of choice whenever possible.

SUMMARY

I might summarize my remarks as follows:

1. There is an unfortunate paucity of investigation on the matter of recurrent or overlooked renal calculi and it would be desirable to have various observers in different clinics undertake such an investigation.

2. Roentgenographic examination during or very shortly after convalescence is essential for the accuracy of the results in such a piece of work.

3. While the few data which are at hand show that stones are subsequently found in the kidney after operation in a surprising number of instances, it is impossible to say which of these stones are "recurrences" and which are "left overs." Actual recurrence is unquestionably very frequent.

4. The complex character of the interior of the kidney, hæmorrhage from its mucosa, and the comparative inaccessability of this organ in many cases contribute to the difficulties in removing all stones.

5. Although various procedures may be resorted to for this purpose, none is infallible. It would appear that the fluoroscope offers the most promising prospects for success.

6. Pre-operative study cannot be too painstaking, nor must the possibility of superimposed shadows of calculi be overlooked.

7. A second operation for the removal of remaining stones is advisable in most cases and should be done soon after first operation.

8. Pyelotomy is unquestionably the operation of choice and is often advantageously combined with partial nephrotomy.

PRIMARY TUMORS OF THE URETER[1]

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A SURVEY of medical literature reveals 47 cases of primary epithelial tumors of the ureter. Of these only four were squamous-celled carcinomata. In a study by Kretschmer, 44 cases of leucoplakia of the urinary tract were compiled. A patient presenting both of these rare conditions came under my observation and care. The history and findings are herewith presented.

Case No. 210343—H. W., male, age 38, was admitted to the surgical service of Dr. Edwin Beer, May 19, 1921.

Three weeks before admission he had an attack of severe stabbing pain in the right flank radiating downward and forward to the groin, accompanied by repeated vomiting, chills, and temperature of 105°. The attack gradually subsided in 5 days. The patient thought he passed a stone, followed by bloody urination for a few hours. Dull, constant pain in the right upper abdomen had persisted since, made worse by bodily motion and ingestion of food. There was marked nocturnal frequency. The only point of interest in his past history was that he had a kyphosis since childhood.

Physical examination showed in addition to the lumbodorsal kyphosis, tenderness in the right costovertebral angle. The urine was cloudy, showed some albumin, many pus cells, and a few red blood cells. The roentgen examination showed one large, and three smaller calculi in the right kidney: the smallest appeared in the periphery, the others in the pelvis. Fusion of the twelfth dorsal and first and second lumbar vertebræ was seen.

Cystoscopy showed an intense diffuse cystitis with flakes of pus and fibrin adherent to the bladder wall and marked œdema of the sphincteric region. Ureter catheters were passed to both pelves, and a good flow obtained from both sides. The right side yielded pale, turbid urine with no indigo excretion. It contained much pus, 0.3 per cent urea, culture negative. The left side yielded a clearer, more concentrated urine with pale indigo excretion in 25 minutes. It contained some leucocytes, 0.9 per cent urea, culture negative.

The phenolsulphonephthalein test showed 30 per cent excretion in 2 hours.

Blood chemistry showed urea nitrogen 26.6; incoaguable nitrogen 74.7; uric acid 4.1; creatinin 2.4.

Blood Wassermann negative.

In view of the poor functional power of the left kidney as shown by the indigocarmine test, and the presence of some pus in the urine from the left kidney, a conservative operation was planned. Because of recent fever and chills, pyelography was omitted.

Operation. On May 25, 1921, under general anæsthesia, the right kidney was exposed through an oblique lumbar incision. It was found twice the normal size, its pelvis tremendously enlarged and dilated. At the ureteropelvic junction an indurated mass about 1.5 centimeters in length was felt and was thought to be an impacted calculus. The kidney was delivered with some difficulty because of adhesions, and the pelvis emptied of its fluid content by an aspirating syringe and needle. Culture of this fluid subsequently showed hæmolytic streptococci. An incision 5 centimeters in length was made on the anterior aspect of the pelvis in a longitudinal direction, and three stones and several masses of fibrinous exudate were removed.

The fourth calculus, localized by palpation in a calyx near the periphery at the middle of the convex border, was removed through a centimeter incision of the cortex. This incision served for a drainage tube later. Fluoroscopy by Dr. Bendick showed all stones had been removed. The ureteropelvic junction was then examined and found to be the site of a stricture 1.5 centimeters in length, admitting a small probe. The pelvic incision was therefore extended through the strictured area. The density of the scar tissue aroused my curiosity and I therefore excised a longitudinal section for microscopic examination. The longitudinal incision in the ureter was now closed in the opposite direction, and a large ureter catheter passed well down the ureter and led out through the nephrotomy wound by way of the pelvis. The pelvis was then closed with interrupted sutures, and reinforced by fatty tissue. A small tube was introduced through the nephrotomy wound. Rubber dam was placed in front and behind the kidney and the greater part of the wound was closed in layers.

The stones consisted of calcium carbonate and oxalate, and ammonio-magnesium phosphate. To our great surprise the tissue removed from the ureter stricture proved to be squamous-celled carcinoma. It was, therefore, indicated to remove the ureter and kidney. If a frozen section had been made the complete operation could have been done at the first procedure.

Operation. June 1, 1921, under general ether anæsthesia. The technique of nephro-ureterectomy described by Dr. Beer was employed with this modification, namely, that the ureter was isolated extraperitoneally and divided close to the bladder as the first step of the procedure. The division and liberation of the lower ureter before doing the nephrectomy had these advantages: (1) it minimized the risk of sending tumor cells down through

[1] From the Surgical Service of Edwin Beer, M.D.

Fig. 1. Leucoplakia of renal pelvis.

the ureter during the manipulations necessary for the freeing of the kidney and upper ureter; (2) it eliminated one shift in position of the patient necessitated by the technique hitherto described; (3) it minimized the chances of infecting the anterior wound after working in the infected field produced by the previous operation (the pelvis contained fluid showing hæmolytic streptococci).

Through a three-inch low pararectus incision, the ureter was isolated extraperitoneally, divided between ligatures close to the bladder, and the stump carbolized. The proximal part was freed as high up as possible, dropped back, and the wound closed with a small tube drain into the retroperitoneal space.

The patient was then turned on his side. The wound of the former operation was reopened and found to be extensively infected with much pus and fibrinous exudate. The upper ureter was freed and the whole ureter brought out. The kidney was then easily extirpated, the vessels being isolated and ligated separately. The wound was packed with a Mickulicz tampon.

Gross pathology. Specimen consists of the right kidney and ureter. The kidney is about twice the normal size and its surface shows a fibrinopurulent exudate, the result of infection following the previous operation and drainage. On its convex border at about its middle is a small nephrotomy wound, 2 centimeters in length, the tract leading into the kidney pelvis and showing necrosis and inflammation in the adjoining parenchyma. The pelvis and ureter are greatly dilated and their walls markedly thickened. At or below the ureteropelvic junction is an annular constricting growth irregular in outline, hard, 1.5 centimeters in length and showing a somewhat elevated, red, granular surface. The pelvis is widely open (previous suture line reopened during course of second operation). On splitting its anterior aspect upward, continuing the pyelotomy wound, the pelvis is seen to be bifid, one part leading to the upper, the other to the lower half of the kidney. The upper pelvis and calyces present a fairly normal surface, except for some broken-down, adherent blood clot. The lower pelvis and calyces, however, contain grayish white, somewhat greasy flakes, free, or loosely adherent to the mucosa. The latter is almost completely covered by dull, grayish white, slightly elevated, irregular membrane which can readily be peeled off in flakes. At the entrance to the upper pelvis and on the septum between the two is a more glistening, finely wrinkled, parchment-like area. Midway between this patch and the neoplasm is a less well defined area with no wrinkling or elevation. The condition is one of leucoplakia.

It is difficult to be sure whether the tumor is at the ureteropelvic junction, or whether it was at a point below, with subsequent dilatation of the ureter above the obstruction. The ureter below the growth shows no gross evidence of leucoplakia, although the surface is very smooth and lacks the normal markings. The kidney tissue itself is fairly preserved and shows no evidence of marked inflammatory changes. (See Figs. 1 and 2.)

Microscopic pathology.[1] 1. Section through leucoplakic patch of pelvis (Fig. 3). This presents a perfect reproduction of epidermis as it exists in the less exposed, less thickly covered parts of the body. On the surface is the desquamating hyaline layer of flattened fused cells without nuclei (stratum corneum). The stratum lucidum is not present distinctly. Then comes a layer of two or three cells deep, with flattened polygonal cells, filled with deeply staining granules of keratohyaline substance (stratum granulosum). Next is a layer four to eight cells deep, of polyhedral cells becoming columnar in the depth and showing distinct intercellular bridges (stratum germinativum). The stratum cylindricum (deep columnar layer) appears to rest on an even, well-defined basement membrane. There is no tendency to papilla formation. The underlying connective tissue presents many blood vessels, lymph spaces, and foci of round cell infiltration.

2. Section through pelvis (or ureter) near the neoplasm (Fig. 4). The sharply defined layers described above are wanting; nevertheless the epithelium is flattened, polygonal, of the prickle cell type. The deeper cells are swollen, irregular in outline and

[1] I am indebted to Dr. J. H. Globus for the photomicrographs.

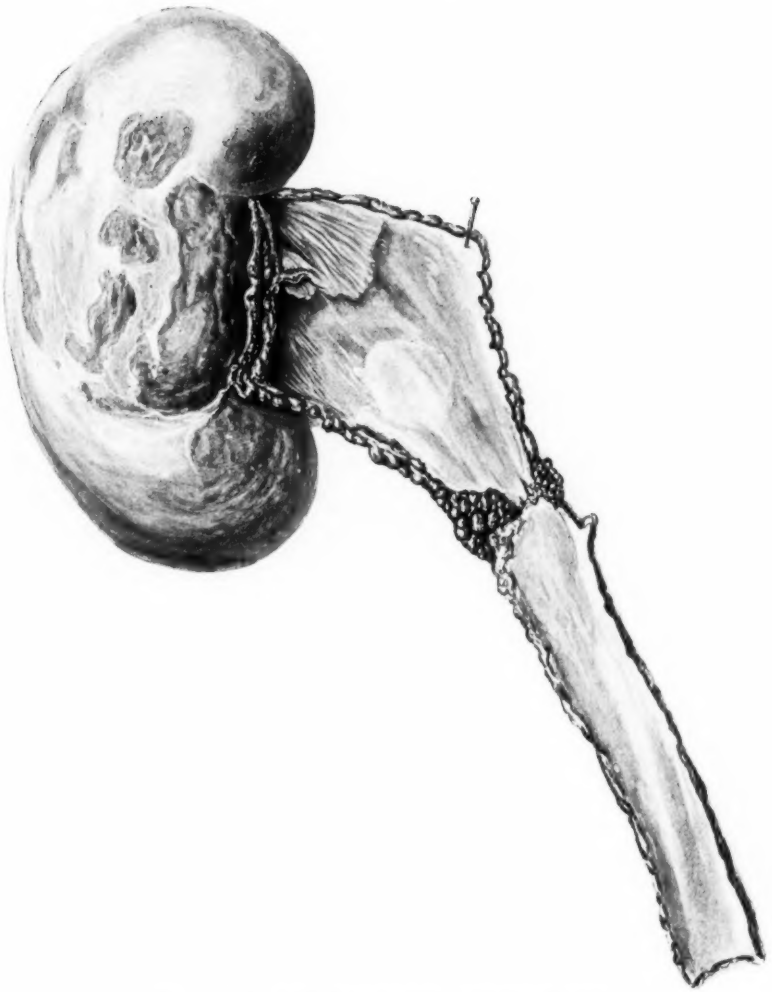

Fig. 2. Leucoplakia of renal pelvis, carcinoma of ureter.

vacuolated. The subepithelial tissues show more inflammatory infiltration.

3. Sections through the neoplasm (Figs. 5 and 6). The epithelium has taken on a disordered rapid growth. The cells on the surface are large, irregular, vacuolated with large irregular vacuolated, deformed and mitotic nuclei. Infiltrating strands spread into the inflamed vascular connective tissue down to and even into the muscle layers. In the depths bizarre forms are seen, and tendency to whorl formation, with hyaline centers (pearls). It is a typical squamous-celled carcinoma.

4. Section through lower part of ureter (Fig. 7). The surface presents a more normal, wavy outline, due to the usual folds. The epithelium is six to eight cells deep. The cells are of the cuboidal, transitional type. The more superficial ones appear swollen. The subepithelial stroma shows marked round-cell infiltration. There is no evidence of leucoplakia.

The specimen, therefore, is one of a hydronephrotic, infected kidney with bifid pelvis, with leucoplakia, and squamous-cell carcinoma of the upper ureter.

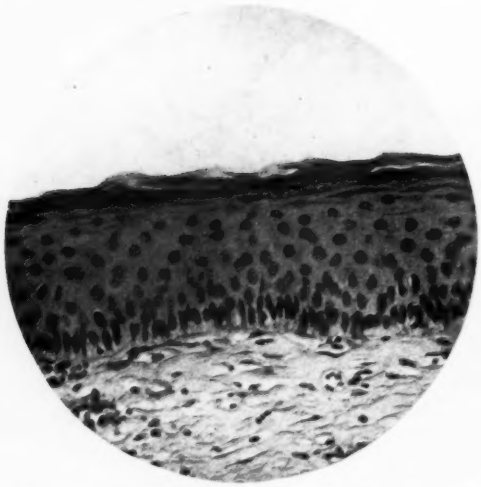

Fig. 3. Leucoplakia of renal pelvis, section showing well defined layers of epidermis.

Fig. 4. Leucoplakia in vicinity of the neoplasm.

Subsequent course. In view of these findings it was reasonable to suppose that the pus in the opposite kidney was due to a leucoplakic condition. After operation flakes in the urine were examined and proved to consist of desquamated squamous epithelium.

The abdominal wound healed with little discharge of pus from the drainage tract. The lumbar wound was treated with Dakin's solution and healed by granulation. The patient was discharged on July 12, about 2 months after his admission.

Vesical symptoms and cloudy urine continued, however. Cystoscopy showed two well-defined, glistening, silvery white areas behind the trigone, in addition to a diffuse cystitis. Specimens removed from these areas showed typical leucoplakic changes.

In November, 1921, the patient was presented before the Section of Urology, New York Academy of Medicine. He was suffering considerably from the cystitis and vesical leucoplakia. In discussion Dr. Benjamin Barringer suggested radium therapy and at my request he made an intravesical application in January, 1922. The patient reacted badly to the treatment. In February uræmic symptoms developed, but the patient refused hospital care and he died of renal insufficiency at his home. Autopsy was, unfortunately, not obtainable. The remaining kidney it will be remembered was poor at time of operation.

It is interesting to speculate upon the sequence of pathological events in this case. It seems probable that the leucoplakia of the urinary tract preceded the formation of calculi. These were of the soft variety often seen in infected kidneys with stasis, and had none of the branching or coral form seen in primary pelvic stones. The passage of a stone or the ulceration due to impaction added to the irritation of infection at the ureteropelvic junction or at a point shortly below it. With leucoplakia existing at this point, the trauma and chronic inflammation stimulated the squamous epithelium to proliferate and develop into an epithelioma. The tendency of epidermis to develop malignancy when out of its normal environment is shown by an experiment performed by Pribram and Finger.[1] A scrap of epidermis transplanted in the peritoneum developed into a tissue like a horny cancer.

It is not my purpose to enter into a detailed discussion of the etiology and nature of leucoplakia. The most authoritative articles on the subject are referred to in the bibliography. Marchand first believed it was a replacement of the normal epithelium by a process of invasion from the true skin. Albarran explained it on the basis of embryonal heterotopia. Hallé regarded it as a true metaplasia, and it seems to me that the weight of available evidence is in favor of this view. Ziegler noted its almost constant

[1] Arch. f. klin. Chir., 1921, cxviii, 768.

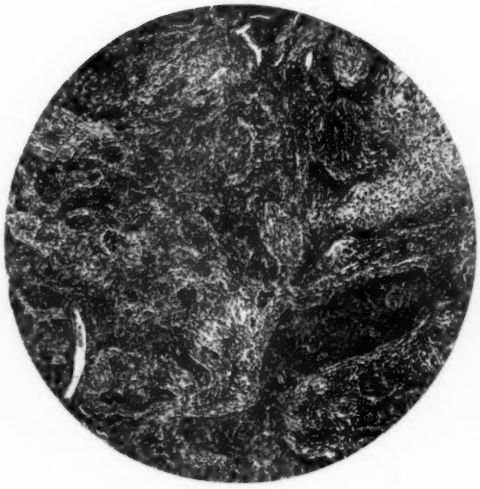

Fig. 5. Squamous-cell carcinoma, low power.

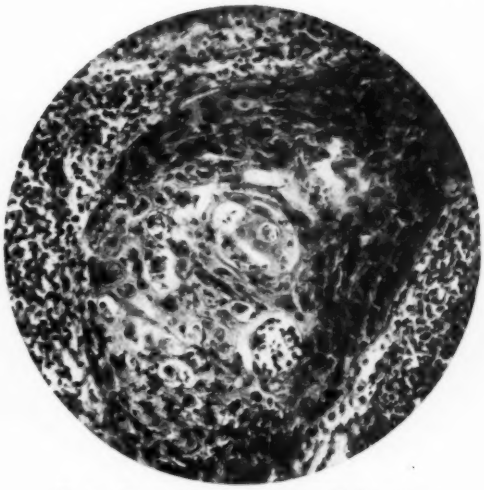

Fig. 6. Squamous-cell carcinoma, high power.

association with chronic inflammatory processes of tuberculous or non-tuberculous origin, although Leber believed it could occur congenitally, and Kischensky pointed out that in rare instances all evidence of inflammation was lacking. Most authors, including Kischensky, Wendel, Weichselbaum, and Kaufmann, felt that its presence predisposed to development of squamous-cell carcinoma. Hallé was strongly inclined to this view.

That it is not an indispensable forerunner of malignant growths of this type, however, is evidenced by the fact that of nineteen such tumors of the renal pelvis collected by Spiess, leucoplakia was present in only three. In 90 cases of bladder tumors collected by Hinman and Gibson leucoplakia was present in only 6.

An analysis of the data available in the reported cases of primary ureter tumors is presented in table form, and the observations of diagnostic and therapeutic value summarized. The cases are grouped according to the pathology. The case numbers in the tables correspond to the bibliographic numbers.

I. Papillomata 21
II. Papillary carcinomata 12
III. Non-papillary carcinomata 14
A. Squamous cell. . . . . (4)
B. Carcinoma solidum seu medullare . . . . . (10)

I. PAPILLOMATA OF THE URETER

Of the 21 cases, 8 are reports of autopsy specimens. Eight cases occurred in individuals under 45 years of age. Eleven were in males, 8 in females. Hæmaturia was known to have occurred in 11, hydronephrosis in 10.

The diagnosis was established by autopsy in 10. Two of these were cases operated upon without discovering the lesion (one, nephrotomy; the other, nephrectomy, and exploratory cystotomy). In 4 cases the tumor was seen protruding from the ureter orifice by cystoscopic examination prior to operation. In Le Dentu's case nephrotomy was done with resultant persistent fistula. An obstruction in the ureter was demonstrated by the failure of methylene blue to appear in the bladder urine after its injection through the lumbar fistula. Cystoscopy then revealed a fringe of papilloma protruding through the ureter orifice. Marion destroyed a papilloma near the ureter orifice by fulguration, but bleeding continued. He re-examined, saw blood issuing from the orifice, and encountered an obstruction at 5 centimeters. In Culver's case the kidney had been removed by another surgeon without stopping the hæmaturia, and cystoscopy showed obstruction and bleeding at 23 centimeters. A ureterogram demonstrated that the ureter

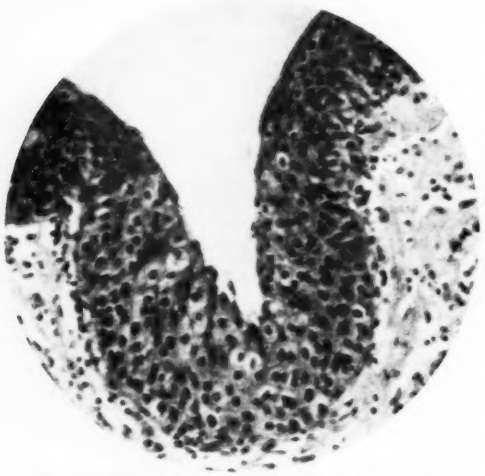

Fig. 7. Transitional epithelium of lower ureter.

extended 4 centimeters up above the end of his catheter. Beer made the diagnosis by excluding calculus, by finding a constant obstruction at 7 or 8 centimeters, and by being able to induce bleeding with the catheter during a free interval.

The following operations were performed in attempts to diagnosticate or cure: For tumors protruding into the bladder: transvesico-ureteral removal, 2; transvesical resection with re-implantation of the ureter, 2; all successful. In one of the first group a nephrectomy was done for secondary pyelonephritis. For the invisible tumors: nephrotomy, 2; nephrectomy, 4; of which only one met the indication because the growth was in the upper ureter. In Suter's case there was a series of operations: exploratory cystotomy, exploratory on kidney for essential hæmaturia, nephrectomy, and finally ureterectomy which cured the patient. Walter did a primary ureterectomy, leaving the kidney in. Culver did a secondary ureterectomy, the kidney having been removed by another surgeon. Secondary nephro-ureterectomy was done in Le Dentu's case, after nephrotomy. Primary aseptic nephro-ureterectomy was done in Beer's case only. Marion apparently cured his case by fulguration with the electrode at the bleeding ureteral obstruction.

Neelsen's specimen was of unusual interest. The ureter bifurcated 5 centimeters above the bladder. The lower branch and pelvis showed no abnormality. The tumor was located in the upper part of the upper branch and the corresponding portion of the kidney presented marked ectasis with destruction of the parenchyma. The diagnostic difficulties under such circumstances are apparent. Ureteral calculus was associated with the growth in four instances.

II. PAPILLARY CARCINOMATA OF THE URETER

Of 12 cases, 5 are reports of autopsy. Eight cases occurred in males, 4 in females. Only one patient was under 45. Hæmaturia was noted in 11, and hydronephrosis in 8 cases.

In the cases of Finsterer and of Judd and Struthers a growth was seen cystoscopically. Richter diagnosed tumor by the presence of atypical epithelial cells in the urine. Chevassu and Mock saw blood issuing from the ureteral orifice and encountered obstruction at two levels with increase of bleeding upon manipulating the catheter. Chiari found an obstruction at 8 centimeters and obtained only some bloody exudate.

The operative procedures employed were the following: In Finsterer's case 14 centimeters of the lower ureter were resected and the proximal end reimplanted. At the time of the report the patient was apparently well, but the author could not exclude the presence of other tumors higher up. Nephrectomy was performed three times, followed by ureterectomy in two (Van Capellen, Judd, and Struthers). In Israel's case autopsy after splenectomy and nephrectomy revealed the true condition. Primary nephro-ureterectomy was performed by Chevassu and Mock, and Chiari. It was attempted by Metcalf and Safford, but the case was inoperable.

Ureteral calculus was present in two cases. Periureteral infiltration, regional lymph nodes or distant metastases (in spine, liver, or lungs) were present in 5.

III. NON-PAPILLARY CARCINOMATA OF THE URETER

There are 14 of these, of which 7 are autopsy reports. Four were squamous-cell

I.—PAPILLOMATA OF THE URETER

No.	Age	Sex	Symptoms				How diagnosed			Situation	Associated lesions
			Duration	Hæmaturia	Pain	Hydronephrosis	Cystoscope	Operation	Autopsy		
1	36	F	2 yrs.	x			Protruding tumor	Transvesical removal, recovery		L. lower	L. diseased adnexa
2	61	M	1 yr.	x	x	x	Bleeding obstruct. at 8 cm. R.	Nephro-ureterectomy aseptic, recovery		R. lower	R. Hydronephrosis Adenoma of prostate
3						x			x	Upper	Hydronephrosis Calculus in growth
4	60	F	2 mos.	x			Protruding tumor	Transvesical resection ureter re-implanted, recovery		R. lower	
5	35	F	2 yrs.	x	x		Bleeding obstruct. 23 cm. L.	1. Previous nephrectomy elsewhere 2. Ureterectomy, recovery		L. upper	
6	32	M	10 yrs.	0	x		Protruding tumor	1. Transvesical removal 2. Nephrectomy for pyelonephritis, recovery		R. lower	
7	60	M		x	x			1. Nephrectomy 2. Explor. cystotomy	x	L. lower	
8	42	F				x			x	L. upper	Hydronephrosis
9	Young	M	Yrs. (food particles in urine).						x	R. diffuse	Pelvi-duodenal fistula
10	64	F	5 mos.		x	x			x	L. diffuse	Hydronephrosis
11									x	Upper	Flat epithelium covering villi
12	33	M	5 yrs.	0	x	x	After 1st op. protruding tumor seen	1. Nephrotomy 2. Nephro-ureterectomy, recovery		R. upper and lower	Calculus in upper Hydronephrosis
13	78	F	5 mos.	x			Protruding tumor	Transvesical resection ureter re-implanted, recovery		R. lower	
14	66	F		x			Bleeding obstruct. at 5 cm.	Fulguration		Lower	
15	70	M		0		x		Nephrotomy	x	L. diffuse	
16	57	M				x			x	R. upper	Bifid ureter
17	67	M	2 yrs.	x		x			x	Upper	Calculus
18		M		x		x			x	Upper and lower	
19	55	M	6 mos.	x				1. Explor. cystotomy 2. Nephrectomy 3. Ureterectomy, recovery		R. lower	
20	32	F	16 yrs.	x	x	x		Nephrectomy		R. upper	Calculus
21	38	M						Cystotomy and ureterectomy, recovery		L. lower	

carcinomata. No mention of associated leucoplakia is made. Five occurred in males, 9 in females. Hæmaturia was noted in 4, and hydronephrosis in 8. Four were below the age of 45.

A protruding tumor was observed cystoscopically twice, and obstruction to the ureter catheter twice. In Quinby's case, the ureterogram showed a large filling defect corresponding to the site of the tumor.

The kidney was tapped once, nephrotomy was performed once, and nephrectomy once. In two cases exploration proved the cases inoperable. In Quinby's case ureterectomy and subsequent nephrectomy yielded a good result.

In 11 instances periureteral extension or metastasis made the case hopeless. The disease apparently spread early and extensively. Calculus was noted twice.

Jona's case of tumor arising in a small diverticulum was classified as a benign pap-

II.—PAPILLARY CARCINOMATA OF THE URETER

No.	Age	Sex	Symptoms				How diagnosed			Situation	Associated lesions
			Duration	Hæmaturia	Pain	Hydronephrosis	Cystoscope	Operation	Autopsy		
22	69	M	8 wks.	x					x	L. lower	Spinal metastasis
23	46	F	yrs.	o	x	x		1. Nephrectomy 2. Ureterectomy 5 mos. later, recovery		R. lower	
24	53	M	5 wks.	x		o	Obstruct. and bleeding, two levels	Nephro-ureterectomy, recovery		L. middle	
25	54	F	3 mos.	x			Obstruct. and bleeding 8 cm.	Nephro-ureterectomy, recovery		L. lower	
26	35	M	4 yrs.	x			Protruding tumor	Lower ureter resected Re-implantation, recovery		L. lower	
27	60	F	10 yrs.	x	x	x		Splenectomy and Nephrectomy	x	L. Multiple infiltrating	Metastases
28	48	M	2 yrs.	x		x	Protruding tumor	1. Nephrectomy 2. Ureterectomy and partial bladder resection, recovery		R. lower	
29	73	M				x			x	L. upper	
30	47	M	yrs.		x	x		Nephrectomy and partial ureterectomy		Lower	Ureteral calculus villi in pelvis
31	65	M	4 mos.	x	x	x			x	L. lower	Calculus Metastases
32	80	F	3 mos.	x		x			x	R. lower	Metastases
33	68	M	4 mos.	x		x	Atypical epithelial cells in urine		x	L. lower	Metastases

illoma by Spiess, but from the author's description I believe it was an early carcinoma. Quinby called his case a mesothelioma, but from the pathologist's report of the histology it appears to be a carcinoma.

DIAGNOSIS

The chief manifestations of tumors of the ureter are hæmaturia, pain due to either renal colic, chronic distention of the kidney pelvis, or periureteral extension, and hydronephrosis. The difficulty of making a pre-operative diagnosis of ureter tumor is shown by the fact that it was attained in only four cases in which no tumor was visible cystoscopically, and in which no previous therapy or operation pointed to the true lesion. From a study of the cases collected, the following findings, separately or in various combinations, are suggestive. Two or more cystoscopic examinations are usually required to secure the necessary data.

I. Cases with visible tumor. A papillary tumor may be found in the trigonal or paratrigonal area, or fine finger-like projections may form a corolla about the ureteral orifice, or a pedunculated tumor may protrude from the orifice constantly or intermittently with the efflux. If cystoscopy is done in a free interval (i.e. no bleeding) one would be likely to attribute the hæmaturia complained of by the patient to the visible tumor or tumors. If cystoscopy is done while bloody urine is being voided, however, one will be surprised to find the blood coming, not from the visible tumor, but from the ureteral orifice on the corresponding side. In some cases with a clear or nearly clear bladder urine, the ureter catheter passing an obstruction near the orifice will yield a bloody urine.

In these cases of visible papillary tumors, a growth higher up in the ureter or kidney pelvis must be suspected. If visible tumors have been removed by forceps or fulguration and bloody efflux from the ureter continues or recurs, the diagnosis is practically certain.

II. Cases with no tumor visible. If cystoscopy is done while the patient is in a free interval, an obstruction in the ureter which bleeds on manipulation of the catheter is suggestive, but calculus must be excluded by X-ray and wax tipped bougie. If the catheter

III.—NON-PAPILLARY CARCINOMATA OF THE URETER

A. Squamous celled

No.	Age	Sex	Symptoms				How diagnosed			Situation	Associated lesions
			Duration	Hæmaturia	Pain	Hydronephrosis	Cystoscope	Operation	Autopsy		
34	53	M	19 mos.	x	x	x	Obstruct. at 6 cm.	Lumbar exploratory	x	R. lower	Metastases
35	46	M	1 yr.	x	x	x		Kidney tapped	x	R. lower	Metastases
36	60	F	1 yr.			x	Protruding tumor	Nephro-ureterectomy attempted	x	R. lower	Metastases
37	36	F	4 mos.		x	x	Epithel. pearls in urine	Nephrotomy	x	R. lower	Calculus Metastases

B. Carcinoma Solidum seu medullare

38	53	M	2 yrs.	x	x	x		Nephrectomy	x	L. lower	Calculus Metastases
39	67	M	9 mos.	x	x	x	Protruding tumor	Transvesical cauterization	x	R. lower	Metastases
40	50	F	8 mos.			x			x	R. lower	Local extension
41		F							x	L. lower	In diverticulum of ureter
42	66	F							x	L. lower	Vaginal perforation
43	40	F	3 wks.				Obstruct. at 14 cm. Defect in ureterogram	1. Ureterectomy 2. Nephrectomy, recovery		L. middle	
44	55	F			x				x	L. upper	Local extension
45	41	F			x				x	R. lower	Metastases
46	89	F				x			x	L. diffuse	
47	41	F				x			x	R. upper	Metastases.

passes an obstruction and evacuates a hæmatonephrosis, one should strongly suspect a primary pelvic tumor with ureteral implantation.

If the examination is made during a period of hæmaturia, bloody efflux from the ureter, with obstruction to the catheter, and increased bleeding upon manipulation is highly suggestive. If on passing the obstruction clear urine is obtained, the diagnosis is practically certain.

A ureterogram may demonstrate a definite filling defect with dilatation above it.

If a nephrectomy has been performed and bleeding continues from the ureter on the same side, the diagnosis is practically certain and may be strengthened by a number of the above findings.

It is evident from the many possible cystoscopic findings that a positive diagnosis is rarely attainable. Ureteral calculus, tuberculous stricture of the ureter, and even simple stricture of the Hunner type must be excluded. In the only case of undoubted Hunner stricture which I encountered, there were attacks of hæmaturia, and bleeding could be induced by manipulating the ureter catheter at the site of obstruction. The subsequent complete relief obtained by ureteral dilatation cleared up the situation.

TREATMENT

In the case of visible tumor proven benign by biopsy, fulguration may be employed, but if ureteral bleeding continues or if there is no visible tumor, aseptic nephro-ureterectomy as described by Dr. Beer is the procedure indicated. A less extensive operation does not meet the indications because, first, the kidney is probably rendered useless already, second, there may be multiple tumors in the pelvis and ureter, third, the tumor may be malignant. A partial resection of the bladder may be necessary in addition, when the growth involves the ureteral ostium.

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ELUSIVE ULCER OF THE BLADDER

A Further Report[1]

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In a previous paper on the surgical treatment of elusive ulcer of the bladder,[2] 5 cases were reported in which the diagnosis was verified by operation and histological examination of specimens obtained.

I now have, including the previously reported cases, the records of 14 cases. Because of the gradually increasing interest in this subject, it was thought advisable to study this larger group of cases with the idea of attempting to bring out any possible new phases of the subject and also to review the previously published cases to determine, if possible, the results of treatment with special reference to the end-results.

The time that has elapsed since the first 5 cases were operated on may not be considered very long (21 months the longest and 16 months the shortest), yet it seemed worth while to get in personal communication with these cases to determine just what has been accomplished.

Likewise it was thought desirable to ascertain the status of the cases operated upon more recently with the same object in view. For this reason the patients were asked to call at the office for personal interviews and for urinary examinations. In some instances the patients lived too far away to report in person and their present status was obtained by personal correspondence. A summary of these cases is given at the end of the paper.

SYNONYMS

Much credit is due to Hunner who called attention to this lesion and outlined a definite surgical procedure in its treatment; namely, wide resection of the ulcer-bearing area. In his report he used the term "Elusive Ulcer" which has been somewhat confusing, since those who become interested in these cases immediately begin looking for something "elusive" when as a matter of fact the ulcers are not at all elusive.

Practically every author writing on this subject has suggested a new name which only adds to the confusion and multiplication of synonyms. Nitze, many years ago, suggested the term "Cystitis Parenchymatosa," but this has not met with much favor since the term has never been used.

ETIOLOGY

Up to the present time it can be stated that the cause of this lesion is unknown. Hunner suggested the possibility of a distant focus of infection as playing a rôle in the etiology, suggesting infection of teeth, tonsils, sinuses, and adenoids. Bumpus and Meisser, following the work of Rosenow, conclude that elusive ulcer and other infections of the urinary organs are due to focal infections harboring streptococci, which have a selective affinity for the urinary tract.

SEX

From the very start one striking feature has been that females have been much more frequently attacked than males. Thirteen of the 14 cases to be reported in this paper occurred in women and only one in a male. Hunner's series (25 cases) all occurred in females; Bumpus reported 15 cases, 13 of which were females; Keene reported 10 cases; Reed, 5, and Fowler, 3, all in women. Hunt reported 20 cases operated upon, 18 of which were females. The only large series of cases in males is reported by Frontz who in 26 cases, reported 23 cases in males and only 3 in females.

Hunt stated that since the teeth, tonsils, and sinuses are foci of infection common to both sexes, it seems that some additional etiological factor other than focal infection must explain the frequency of the lesion in the female and its rarity in the male.

[2] Surgical treatment of so-called elusive ulcer of the bladder. J. Am. M. Ass., 1921, Apr. 9.

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, May 1 and 2, 1922.

Marital state and pregnancy. Most of the authors are agreed that matrimony and pregnancy have no etiological bearing on this condition inasmuch as cases are seen in both the married and unmarried. Ten of the 14 cases are married and 3 have never been pregnant. These 3, with the 2 single women, make a total of 5 who have never borne children.

Careful pelvic examinations were made without finding pelvic pathology, hence lesions of the pelvic organs can be dismissed as etiological factors and also as factors in the production of the urinary symptoms.

AGE

It would seem from the table of ages that this is essentially a disease of adult life. The youngest patient in this series is the one male, aged 24. The oldest patient was 61.

	Cases
21 to 30 years	2
31 to 40 years	6
41 to 50 years	5
51 to 60 years	0
61 to 70 years	1

PREVIOUS OPERATIONS

In no department of surgery is the value of careful pre-operative study so apparent as it is in the field of urological surgery. Genito-urinary surgeons are familiar with the large number of patients with urinary symptoms who have been subjected to various abdominal and gynecological operations without obtaining relief from their symptoms. The large numbers of patients suffering from various kidney lesions, such as stone, tuberculosis, and pyelitis, who have sacrificed their appendices and various pelvic organs, are evidences either of careless diagnosis or insufficient pre-operative study. Cases of elusive ulcer are no exception to this statement.

Thirteen of the 14 cases gave a history of previous surgical operations. These operations can be classified into two groups. In the first group can be arranged the operations which had no connection with the bladder condition and hence have no distinct bearing on this subject. In this group we find 4 cases—3 females and 1 male—who had the following operations: tonsillectomy (2 cases); tonsillectomy and eye operation (1 case); hæmorrhoidectomy and operation for enlarged left testicle (1 case).

The remaining 9 cases had all been operated on previously for relief of their urinary symptoms, but the operations failed to relieve the bladder distress. The urinary organs had been operated on in 2 of these cases. In one case a nephrectomy was performed under the mistaken diagnosis of renal tuberculosis. This case was described in detail in the previous report on this subject.[1] The second patient was operated on and was told that a tumor of the bladder had been removed. The remaining cases had the following gynecological and abdominal operations:

Case 1. Appendectomy, resection of ovaries and shortening of round ligaments.

Case 6. First operation, suspension of uterus; second operation, perineorrhaphy; third operation, hysterectomy; fourth operation, removal of urethral caruncle.

Case 8. Appendectomy and left ovariectomy. Hysterectomy advised just prior to coming under observation.

Case 10. First operation, appendectomy and operation for gastric ulcer; second operation, perineorrhaphy; third operation, perineorrhaphy.

Case 11. First operation, curettement and ovarian tumor removed; second operation, salpingectomy and oophorectomy.

Case 12. Ventral suspension.

Case 13. Curettage.

There was only one patient who had never been subjected to any sort of surgical operation—a female (Case 2).

PATHOLOGY

All the specimens removed at operation were subjected to careful histological examination. The microscopic picture was almost uniform. While the changes varied somewhat in extent and in minor details, the same general picture was found, as a rule, in all 8 cases. The ulcer-bearing area showed a loss of the epithelium. In several instances there appeared to be a flattening of the epithelium, so that, as the edge of the ulcer was approached, the epithelium was much

[1] Loc. cit.

flattened and formed a very thin layer. In one case, the epithelium appeared to have changed to the flat, squamous type of cell. Some of these cells seemed to be hydropic. Occasionally the surface of the ulcer was covered with fibrin and many red blood cells were noted in some of the fibrin masses. The fibrin was not limited to the surface of the ulcer, but extended beyond the edge and over and on to the mucosa. At times red blood cells were seen adhering to the surface of the ulcer.

The most extensive changes were those found in the submucosa which showed many new formed blood-vessels and these were packed full of red blood cells. Round-cell infiltration was seen in the submucosa. There were areas in which the collections of round cells were very small; and in others, large masses of round cells were noted. Some of the sections showed these small, round cells closely crowded together and with the border rather sharply defined, and these areas resembled somewhat the collections of cells seen in so-called cystitis follicularis, rather dense and visible to the naked eye.

Round-cell infiltration was also seen occasionally between the muscle bundles. In several of the sections there were newly formed connective-tissue cells in the submucosa, and here and there the submucosa appeared definitely œdematous. In two of the sections, gland tubules were seen; and these differed in no way from the gland tubules in cases of cystitis glandularis. In one of the sections the cells forming the tubules showed secretion within the cell, so that they had the appearance of typical goblet cells. A combination of follicle formation and gland formation was not found in the same specimen.

The changes in the muscular coat were not so extensive as the changes in the submucosa. Occasionally areas of round-cell infiltration were noted, which, however, were not extensive. In several of the sections the muscle bundles were apparently separated by œdema.

A very striking change was that found at operation, the bladder wall showing an enormous thickening entirely out of proportion to the size of the ulcer. This was so well marked that in several of the cases it was possible to foretell the exact location of the ulcer or ulcers before opening the bladder.

As a rule the peritoneal coat showed decided thickening.

The specimens in 3 cases were turned over to Dr. Dick for special bacteriological examination and he attempted to grow organisms from the ulcers. The technique employed was maceration of the excised ulcer-bearing areas of the bladder. This experiment showed the presence of bacillus coli in Case 5; streptococci in Case 8, and a few colonies of staphylococcus albus and many colonies of diphtheroid bacilli in Case 9.

DURATION OF SYMPTOMS

From a review of the histories it would appear that this is essentially a chronic disease. This, however, may be more apparent than real, and the long duration of the symptoms is undoubtedly due to the fact that although the patients had consulted many physicians and had submitted to many and varied surgical operations, the long period of illness was in reality due to the fact that the condition was not recognized. In one patient the symptoms had been present 17 years, during which period she had been operated upon four different times, the following operations having been performed: (1) suspension of the uterus, (2) perineorrhaphy, (3) hysterectomy, (4) urethral caruncle. Failure of the operative procedures is self-evident.

The shortest duration of symptoms was 11 months and occurred in the only male case in this series. A cystoscopic examination made a few days after admission to the hospital established the diagnosis, and operation gave complete relief of his symptoms.

These 2 cases, from the two extremes of disease duration, are rather striking, showing in the one instance how easy and simple it is to straighten out these cases if the diagnosis is made at once, as against a period of suffering for 17 years, a submitting to four surgical operations, and no relief of symptoms. There does not seem to be any uniformity in the duration of the disease as can be seen from the following table:

	Cases
11 months	1
1 year	1
2 years	2
3 years	1
4 years	2
6 years	2
8 years	1
9 years	1
10 years	1
13 years	1
17 years	1

SYMPTOMS

Of the various symptoms mentioned by these patients, two were constant and present in each case. These symptoms were frequency of urination and pain. The pain was generally described as severe in character, and it was of two kinds: pain that was present more or less constantly and pain that was present during, or aggravated by, micturition. In some instances the patients were unable definitely to localize the pain, simply stating that the pain was located in the bladder. Some were more specific and volunteered the information that the pain and soreness were located in the neck of the bladder. In one case the pain was so severe as to produce spasms of the bladder. In another case, in addition to the pain in the bladder, the patient complained of pain over the right hip, and in another case there was pain in the vagina. In one case the bladder pain radiated to the kidneys; in another, associated with the pain in the bladder, there was a constant pain over both kidneys, which may have been due to the pyelitis that was also present. The pain was often aggravated by the local treatment to which some of the patients had been subjected prior to coming under observation.

Apart from pain in the bladder and radiating pains, there was also present pain on urination. This pain was described in such terms as burning, smarting, cutting, toothache-like, and cramp-like, expressions which would lead one to suspect that the degree of pain was rather severe.

Frequency of urination was found to be present in each and every case, and was more or less constant, the patients never being completely free of this symptom although the degree varied. It would appear that with an apparent or temporary improvement in the local condition there was a diminution in the number of micturitions, both day and night. All these patients were obliged to arise at night, varying from once every hour to once every 20 or 30 minutes, so that they were often below normal as a result of loss of sleep, as well as from the effects of the continued painful urination. In several, the frequency seemed to bear some relationship to menstruation, since there was an increase of frequency just prior to or during the menstrual period.

Hæmaturia. The presence of gross blood in the urine was noted in 6 of the 14 cases. This varied in severity from a slight amount of bleeding, just enough to stain the linen, to the passage of bloody urine with clots. Sometimes the bloody urine was noted only after instrumentation of the bladder, such as the passage of catheters and after bladder lavage. If, during irrigation, the bladder is overdistended, bleeding is easily started. This can be demonstrated very convincingly, if, just prior to the close of the examination, a little more fluid is allowed to run into the bladder so as to cause overdistention.

Other urinary symptoms were not present as constantly as the previously described group. Urgency was mentioned in 6 cases; burning on urination in 6 cases; tenesmus in 3 cases; backache in 6 cases. Gastro-intestinal symptoms were rather insignificant. Nausea and vomiting, as well as rectal symptoms, were absent. Constipation was present in 6 of the 14 cases, and considering that all were women, with the exception of one, this is not of any moment. Chills and fever were present only once.

Roentgen-ray examinations of the urinary tract were made in each case. No evidence of calculi was found in the kidneys, ureters, or bladder. Wassermann reactions were negative in each case. Guinea-pigs were inoculated and were negative for tubercle bacilli in every case. Careful examinations of the teeth, tonsils, and sinuses were made for foci of infection with the following results:

Case 1. Tonsils slightly enlarged. Teeth in good condition.

Case 2. Tonsillectomy advised.

Case 3. Tonsillectomy advised. Also removal of two teeth.

Case 4. Tonsils absent. Urethral discharge and inflammation of Skene's glands.

Case 5. Asthma for 20 years. Teeth negative. Slight cloudiness in X-rays over right side. Possibly, antrum infection.

Case 6. No examination.

Case 7. X-rays of teeth negative.

Case 8. Pus expressed from tonsils. Tonsillectomy advised.

Case 9. Tonsils absent.

Case 10. No examination.

Case 11. No examination.

Case 12. No examination.

Case 13. Many infected teeth removed after coming under observation.

Case 14. Watery discharge from right antrum. Tonsils absent.

In 13 of the 14 cases accurate records of urine studies were available. (See Table I.)

TABLE I.—STUDY OF URINE

	Leucocyte count			Cultures			Red blood cells
Case	Right	Left	Bladder	Right	Left	Bladder	
1	40	50	7,290	B. coli	B. coli	B. coli	None
2	1,420	160	1,080	Sterile	Sterile	Sterile	Few
3	6	No spec.	150	Sterile		Sterile	None
4			70			B. coli Staph.	None
5	74	34	105	B. coli	Sterile	B. coli	Positive
6			82			Not made	Few
7			Not made			Sterile	None
8			0			Strep. Staph.	None
9	80	RBC	Debris	Staph.	Sterile	Staph.	Positive
10	No	record					
11			116			Staph.	No record
12	0	0	0	Sterile	Sterile	Sterile	Positive
13			525			Sterile	None
14	227	110	173	Sterile	Diph.	Diph.	

A review of the table shows only one patient who had a normal urine. Seven cases had some pus in the urine. The amount was variable. Leucocyte counts were made in these cases in order to have a more or less accurate record of the amount of pus present. The highest count was found in Case 1, in which 7,290 pus cells per cubic millimeter were found. The lowest count was 70 cells.

In 7 cases the ureters were catheterized. In Cases 2 and 14 pus was found on both sides. In Cases 5 and 9 counts are a bit high in urine obtained from the right kidney.

Cultures were made with the following results. In 5 cases sterile urines were found; in 3 cases one kidney only was sterile. In the remaining cases positive cultures showed both kidneys and bladder infected with bacillus coli (1 case); bladder and right kidney with bacillus coli (1 case); colon and staphylococcus (1 case); streptococcus and staphylococcus (1 case); staphylococcus in right kidney and bladder (1 case); staphylococcus only (1 case); diphtheroids in left kidney and bladder (1 case). The statement that the colon bacilli outgrow other organisms apparently does not hold in this group of cases. Red blood cells were found in the urine in 5 cases.

CYSTOSCOPY

The prominent feature in this group of cases is that the cystoscopic examination was painful and the bladder capacity very limited. Cystoscopically the ulcers varied in size from a pinpoint to 2 cubic millimeters in diameter. The area of ulceration was surrounded by a zone of hyperæmia which was sharply circumscribed, and by the bladder mucosa which appeared normal. The surface of the ulcer may be covered with mucopus. Areas of œdema around the areas of ulceration were not seen. Overdistention of the bladder was the cause of pain and of starting hæmorrhage, which was so profuse at times as to interfere with the cystoscopic examination.

The cystoscopic picture is variable, depending on the state of healing of the ulcer. This has led to the term "elusive ulcer," which term has been rather confusing.

In case the surface of the ulcer is healed, there is seen a definite area in which there is an increased vascularity. Most often, however, definite ulceration is seen. Many times it is necessary to carry out repeated cystoscopic examinations before making the final diagnosis. In several instances the lesion was at first confused with tuberculosis.

Location. In 9 cases the area of ulceration was seen in the apex of the bladder, that is, the dome of the bladder. In 3 cases, areas of ulceration were seen on the posterior wall only. In 2 cases the left lateral wall was the site of the ulceration and in one case the anterior wall was the seat of ulceration. In some of the cases there was more than one area of ulceration. In one case there were areas of ulceration near the right ureteral orifice in addition to ulcers in the apex.

Diagnosis. Once the condition was recognized, it was not difficult to diagnose in the subsequent cases. Because of the history of long-standing distress, the extreme pain in introducing the cystoscope, which in some cases necessitated the use of anæsthesia, the limited bladder capacity, and the presence of areas of ulceration in the bladder, my chief concern was in regard to the exclusion of tuberculosis. This was effected by diligent search for tubercle bacilli in stained specimens as well as by repeated guinea-pig inoculations.

TREATMENT

The concensus of opinion among urologists is that this is a surgical condition and that once the diagnosis is made, nothing short of an operation will suffice. Indeed, it is the last choice as far as our therapeutic agents are concerned, since the majority of these patients have had all sorts of local treatment, the only result of which seems to be an aggravation of symptoms.

Wide resection of the ulcer-bearing area is the only treatment that has been carried out in this series with the exception of two cases which were treated by fulguration. In one case fulguration had been instituted elsewhere, and although most authors condemn this form of treatment, yet the result in this case (perhaps temporary) was rather striking, as brief résumé of patient's history shows.

Mrs. M., age 38. Symptoms started 3 years ago with nocturia, burning on urination, urgency, and cloudy urine. Condition gradually became worse, and one year after onset of trouble patient was cystoscoped and a diagnosis of ulcers of the bladder made. Fulguration treatments were instituted, resulting in almost complete relief of symptoms. Her last treatment was 6 weeks before coming under our observation. She came in for fulguration because of a gradual return of symptoms. Three weeks after the last fulguration she was delighted with the result and voided only twice during the night before reporting at the office. A recent letter from her physician states that she is completely relieved of her symptoms.

RESULTS OF TREATMENT

CASES OPERATED UPON

CASE 1. Mrs. P., age 28. Onset of symptoms 9 years ago. Left nephrectomy performed for renal tuberculosis; no improvement. Complained of frequency of urination, varying from every 3 minutes to 1 hour, and of pain in bladder; hæmaturia. Eighteen months after resection of ulcer, patient stated, her urinary condition was very satisfactory and it was almost impossible to believe that she could get along so nicely after having had so much trouble. She has been able to go for as long as 8 hours without voiding.

CASE 2. Mrs. G., age 42. Trouble started 4 years previous to operation, with pain on urination, frequency every half hour, and nocturia from two to eight times; pyuria, hæmaturia; pain in back and pain in bladder during movements of the bowel. Twenty-five months after operation, patient is free of all urinary symptoms. Still has pain in the back due to pyelitis. Now voids four or five times in the day and once at night. A recent examination of the urine showed a faint trace of albumin, a few pus, and red blood, cells. Cultures showed bacillus coli and a cell count of 92.

CASE 3. Mrs. T., age 32. Symptoms began 2 years ago with burning on urination, hæmaturia, and urgency. Later, pain in the bladder and frequency, every half hour in the day and seven to eight times at night. Eighteen months after operation patient says she feels she is entirely cured of her urinary trouble. She now voids every 2 or 3 hours in the day and occasionally gets up once at night. No burning or hæmaturia.

CASE 4. Miss K. D., age 32. Symptoms present 1 year and complained of pain in bladder, frequency, urgency, and loss of weight. Seventeen months after operation patient states she is enjoying excellent health. No urinary symptoms, but quite frequently she has a feeling of soreness in left side of bladder. Otherwise thinks she is 100 per cent cured.

CASE 5. Miss D., age 46. Before operation complained of painful urination, frequency, and nocturia. Onset 4 years ago. Was operated on and a growth was removed from the bladder. Hæmaturia was relieved by operation but other symptoms persisted. Fourteen months after operation, patient stated she felt well until lately; at present has pain in bladder and soreness, especially on walking.

CASE 7. Tony M., age 24. Symptoms started 11 months ago with painless hæmaturia. Two weeks later slight burning on urination and pain in perineum. Frequency many times a day and also nocturia present. Eight months after operation, cystoscopic examination showed the bladder absolutely negative; bladder capacity 15 ounces. No pain, frequency, or nocturia at present.

CASE 8. Mrs. K., age 35. Onset of trouble 13 years ago, starting with frequency of urination, burning, pyuria, and fever. Later, backache, pain in bladder and in vagina. Five years after onset of trouble, appendix and left ovary removed without relief of symptoms. Last October patient was operated upon for elusive ulcer; 5 months later stated she was feeling quite well but still has trouble holding the urine. Can hold the urine for

about 2 hours, but after that has pain in the bladder. This condition is present day and night. Before operation, she voided every hour, day and night.

CASE 9. Mrs. C., age 48. Six years ago patient had an attack of frequency and burning on urination following a cold. Every winter since that time, patient has had similar attacks, lasting a week or more. She complained of retention, marked urgency, hæmaturia occasionally, backache, and pain in bladder. Nine weeks after operation, patient states, her frequency is much improved, voiding every 2 hours in the day and about three times at night. No blood in the urine since the operation, and patient can retain the urine for some time after having a desire to void. She thinks she has gained in weight. Still has an occasional slight backache.

CASES NOT OPERATED UPON

CASE 6. Mrs. C., age 49. Symptoms started 17 years ago after birth of her second child, at which time she had pain in bladder, pain in right kidney region, pain in right inguinal region, and frequency. Four operations were performed for this trouble: suspension of the uterus, perineorrhaphy, hysterectomy, and removal of urethral caruncle. She has had no treatment of any kind since coming under observation. In past year her condition has greatly improved and she has suffered less than at any time in the past 18 years.

CASE 10. Mrs. C., age 50. Soreness at neck of bladder started about 2 years ago; also had frequency of urination and nocturia. Not treated; present condition not known.

CASE 11. Mrs. M. Treated by fulguration.

CASE 12. Miss A., age 36. Symptoms began 6 years ago with frequency, pain in bladder, pain and burning in epigastrium; loss of weight. She was operated upon 5 years ago, ventrofixation. Symptoms not relieved; present condition not known.

CASE 13. Mrs. K., age 61. Urinary trouble started 8 years ago with frequency, smarting pain on urination, and tenesmus. Many local treatments; condition at first temporarily relieved and later made worse by bladder irrigations. No treatments for 2 years, and, patient states, at present she has practically no pain and the urine is usually clear, only occasionally cloudy. Every now and then she passes pieces of tissue in the urine. She has not taken any medicine or sitz baths, but occasionally when pain threatens to return uses vaginal douche.

CASE 14. Mrs. S., age 39. Symptoms have been present for 10 years. Started with gradual onset of frequency, burning, and pain in bladder. No treatment until 3 years ago when patient consulted a physician who told her she had inflammation of the bladder and gave her internal medicine. She has had bladder irrigations which relieved symptoms for several months; after stopping irrigations symptoms would recur. Symptoms have never been very acute. In last month she has had a dull pain over the right hip when lying down. Backache has been present continuously for 1 month.

Cystoscopy, August 16, 1921. Bladder capacity about 4 ounces. No stone or tumor seen. Near the internal urethral orifice was seen a very vascular area about the size of a split pea, in the center of which was a darker red area. No œdema. Two similar areas were seen in the apex and one on the left lateral wall. The dark area in one lesion looked like a small hæmorrhage. In front of both ureteral orifices were seen œdema or vesicle formation. During cystoscopy patient developed severe bladder spasm and it was then possible to demonstrate clearly the lesion in the right side.

Cystoscopy, September 28, 1921. Three or four areas of hyperæmia were seen in the apex of the bladder. No real ulcerations seen. Ureteral openings were normal and catheterized without difficulty or obstruction.

Cystoscopy, January 18, 1922. Bladder negative. In the apex of the bladder were seen two areas of hyperæmia the size of a fingernail. These areas were very prominent, well defined, and apparently the site of elusive ulcers covered with mucosa.

Two sets of guinea-pigs were injected with the urine from the right and left kidneys and bladder on September 28, 1921, and January 18, 1922. Both sets were negative for evidences of tuberculosis. Urine was centrifuged many times and careful examinations of the sediment failed to show evidences of tuberculosis.

Patient was fulgurated on April 6, 1922, and on April 12 she stated she was more comfortable than she had been for a year. She has been voiding normally in the day and twice at night. On May 1 she had a recurrence of her symptoms but not as marked as formerly.

SUMMARY

Of the 8 cases operated upon, one is having a relapse and another has pus and staphylococci in the urine. The remaining cases consider themselves well; that is, they are free of symptoms.

Two cases were treated by fulguration with an immediate relief of symptoms. Time only will tell whether this will be permanent.

Of the remaining 4 cases, 2 are no longer under observation and the other 2 have shown an improvement in their condition, this without any treatment. However, these 2 cases are not entirely free of symptoms.

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THE RESULTS OF OPERATIONS FOR CANCER OF THE LIP AT THE MASSACHUSETTS GENERAL HOSPITAL FROM 1909 TO 1919[1]

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THE following paper is based on the cases of cancer of the lip admitted to the Massachusetts General Hospital during the ten-year period from January 1, 1909, to January 1, 1919. This period was chosen in order that three years should have elapsed since operation in every case, and no patient who is not known to have been free from the disease for at least that length of time after operation has been considered as a cure.

There were 172 primary cases admitted to the hospital during this period together with 15 cases of cancer of the lip recurrent from previous operation. The cases were operated upon by 19 members of the surgical staff to whom the writers wish to acknowledge their appreciation for permission to report them. Thanks are also due to Dr. H. F. Hartwell, surgical pathologist, for assistance in reviewing the pathological specimens.

In making this analysis we have reviewed every case admitted to the wards during the ten-year period and in obtaining the figures all cases have been included in which an attempt was made for a surgical cure. In many cases operated upon the disease was far advanced, and it is partly for this reason that the percentage of cures shown is less than that in the series reported by Broders (1) and Bloodgood (2). No case has been accepted as a cure unless a pathological examination of the tissues removed at operation was made, and patients dying within the arbitrary three-year limit without recurrence have been excluded as inconclusive.

The form adopted in reporting this series is one that was first used in a paper on the results of operations on cancer of the buccal mucosa (3), as at that time it was found impossible to compare the statistics with those of other writers. The same form has since been used in reporting two other series of cases (4–5) and has proved very satisfactory. It was possible, in fact, to compare accurately the results of a personal series of cases of cancer of the breast with those of a previous series representing the experience at the Massachusetts General Hospital (6).

The accepted operation for cancer of the lip is excision of the growth, with or without a plastic closure of the defect, and the removal of the fat and glands in the submental and submaxillary space and to the bifurcation of the carotid, from one or both sides of the neck depending on the situation and size of tumor. We shall speak of this hereafter as the radical operation. We have used the term "palliative" operation to describe cases in which the growth alone was excised and no dissection of the neck done. We consider this operation justifiable only in the very early cases which are clinically precancerous, or where the radical operation is contra-indicated on account of the age or physical condition of the patient.

The total number of cases available for study was 187, divided as follows:

Recurrent from previous operation	15
Inoperable or operation not advised	5
Refused operation	4
Radical operations	122
"Palliative" operations	41
Total cases	187

No attempt has been made to determine the end-results in the recurrent cases or those in which no operation was performed. Of the remaining 163 cases, the end-result is known in 138 instances, or 84.7 per cent of the cases.

ETIOLOGY

No new facts in regard to the etiology of cancer of the lip have been brought out by this study. The disease was confined almost entirely to men, there being 170 males and 2 females in the series. The growth occurred on the upper lip 4 times and on the lower 168. People of all ages were affected, the extremes

[1]From the Cancer Commission of Harvard University. Read, by invitation, at the meeting of the American Surgical Association at Washington, May 1, 1922.

being 24 and 93 years of age, although it was more common between 45 and 70. The average age was 54.75 years.

AGES OF PATIENTS

20 to 25 years.....	2	60 to 65 years.....	18
25 to 30 years.....	4	65 to 70 years.....	18
30 to 35 years.....	3	70 to 75 years.....	15
35 to 40 years.....	13	75 to 80 years.....	13
40 to 45 years.....	12	80 to 85 years.....	6
45 to 50 years.....	17	85 to 90 years.....	1
50 to 55 years.....	24	90 to 95 years.....	1
55 to 60 years.....	21	Not stated.....	2

Persistent chapped lips, keratosis, seborrhœa, or leucoplakia of the lips preceded by some time the appearance of the growth in a large group of cases. Sixty-two patients gave a history of some form of irritation of the skin of the lips present for months or years before the appearance of the cancer. Patients with this history are particularly liable to have what we have termed re-occurrence, of the disease, in distinction to recurrence, after the removal of a primary cancer. By re-occurrence we mean the formation of a second cancer of the lip after the removal of a primary growth, the second cancer being on a portion of the lip remote from the scar of the operation. Eight cases in this series are cases of re-occurrence and all presented a well healed scar at one point on the lip and a cancer at another point. Two other cases in the series developed a re-occurrence after removal of the primary growth in the hospital. These were excised and both patients are living and well more than three years after the second operation.

One hundred patients smoked tobacco including 6 who also chewed. Pipe smokers predominated. Nine patients did not use tobacco in any form, while the records are inconclusive in 63. One patient, who did not use tobacco, was a shoe worker and in the habit of keeping nails in his mouth while at work. Broders has shown that the percentage of tobacco users in patients with cancer of the lip is approximately the same as that in a series of 500 patients without cancer of the lip but that the percentage of pipe smokers is much greater.

Wassermann examinations were made at the hospital as a routine procedure during the latter part of the decade studied but not during the first part. There were examinations on only 56 patients. The reaction was positive in 12 and negative in 44 cases. It is interesting to note that in two cases a primary lesion developed at the site of the scar of excision of the cancer of the lip in one of which the nodule was excised under the impression it was a recurrence. In a third case a cancer developed in the scar of a chancre of the lip acquired two years previously.

PATHOLOGY

Specimens from 103 of the 131 patients in whom the end-result is known, were available for re-examination. The tumors varied from the early papillary type of cancer, a condition which might almost be termed precancerous, to carcinoma of the squamous-cell type but with little differentiation of the cells. An attempt was made to grade these specimens into three groups according to their malignancy, the criterion being the amount of differentiation of the cells and the number of mitotic figures. In Group 1 were placed those tumors in which the cells had a marked tendency to differentiate, as shown by the formation of epithelial pearls, and in which mitotic figures were comparatively infrequent. In Group 2 were placed those cases in which there was less tendency to differentiate and evidence of more rapid growth. In Group 3 were placed cases in which the cells infiltrated the tissues and showed little or no tendency to differentiate. This grading was done without knowledge of the clinical side of the case and the results compared later. They are as follows:

RESULTS—PATHOLOGICAL CLASSIFICATION

	Living	Dead
Group 1.....	53 cases (81.5 per cent)	12 cases
Group 2.....	14 cases (70. per cent)	6 cases
Group 3.....	4 cases (22. per cent)	14 cases

It would seem, therefore, that other things being equal, such as the extent of the growth and its duration, the amount of differentiation of the cell has a distinct bearing on the prognosis of the disease.

The presence of palpable glands did not necessarily mean that metastases had oc-

curred, as in many cases in which the presence of glands was noted in the history pathological examination failed to show cancer. It is impossible, however, to say that metastases have not occurred unless serial sections are made of all tissue removed. Metastatic cancer was found in the glands in 24 of the 119 cases in which neck dissection was done and in which we have a report on the glands. Absence of clinically enlarged glands, on the other hand, does not rule out metastases as, in 24 cases in which it was noted in the record that there were no palpable glands, cancer was demonstrated in the tissue removed from the neck in 6, or 25 per cent.

The presence of demonstrable metastatic cancer in the glands was a grave prognostic sign. In the 19 cases in which metastases were found and in which the end-result is known, 5, or 27.7 per cent, are living and well, while in the 72 traced cases in which no cancer was found in the glands, 63, or 86.6 per cent, were cured.

SYMPTOMS

The symptoms consisted of a painless ulcer or tumor of the lip preceded in 62 cases by a history of chapped lips, keratosis or leucoplakia. The first symptom was described as a "sore" or "cold sore" in 83 cases, a "scab" in 19, and a "wart" or "tumor" in 38. In the remaining cases it was variously described as a pimple, crack, blister, cut, etc. In a few cases it was the presence of enlarged metastatic glands in the neck that first led the patient to consult a physician.

The tumor was of comparatively slow growth, the average duration from the onset of symptoms to the admission to the hospital being 11.9 months (data on 156 cases). The delay on the part of the patient from the appearance of the disease to the first consultation with a physician was 4.35 months (data on 123 cases), and the delay from the first consultation until operation was advised averaged 1 month (data on 125 cases).

Palpable glands were noted as being present in the submental or submaxillary spaces or elsewhere in the neck in 119 of the cases but on subsequent pathological examination many of these proved to be inflammatory. The presence of glands had little relation to the size or duration of the tumor except in the obviously far advanced cases. This is not surprising considering the septic condition of the mouth in many of the patients in addition to the presence of an ulcerated or partly necrotic tumor of the lip. The teeth were mentioned as being in poor condition, or carious, in 97 cases.

The situation of the tumor on the lip was as follows:

SITUATION OF GROWTH

	Cases
Right side	51
Left side	57
Center	25
All lip	14
At angle of lips	6
Upper lip	4
Not stated	15

The growth was described in the records under the following headings:

TYPE OF GROWTH

	Cases
"Fungating"	21
Ulcerative	84
Tumor	34
Warty	14
Miscellaneous	19

OPERATION

The radical operation was performed on 122 cases with the removal of the glands from one side of the neck in 73 and from both sides in 49. The operation was performed essentially as follows: A curved incision was made beneath the jaw from the chin to about one inch below and behind the angle. This was carried through the skin and platysma and the flaps reflected. The contents of the submental space was removed and the digastric muscle developed, the facial artery being tied at its entrance into the submaxillary gland. The fat and glands beneath the angle of the jaw and down to the bifurcation of the carotid artery were dissected free and the mass, including the submaxillary gland, removed *en bloc*. The hypoglossal and lingual nerves beneath the submaxillary gland should be recognized and avoided. The branch of the facial nerve supplying the muscles at the corner of the mouth runs between the platysma and the skin a short distance below the angle of the jaw and should not be injured by the incision. It was apparently divided, how-

ever, in a large number of cases with consequent drooping of the corner of the mouth. The wounds were closed in layers, with catgut sutures to the platysma, and drained with a small cigarette wick. If the wounds were not drained, serum and saliva from the intermuscular portion of the submaxillary gland not removed or from the wounded parotid gland, usually collected, necessitating secondary drainage. After closure of the wound in the neck the growth on the lip was excised by a V-shaped incision and the wound closed by sutures to the mucous membrane and skin. If it was necessary to remove a large portion of the lower lip, some form of plastic operation was done to close the defect. Theoretically a bloc dissection, removing the growth on the lip with the glands from the neck in one piece, is the operation of choice, but practically, if the wound in the neck connects with the oral cavity, extensive sepsis usually supervenes.

When the glands were removed from both sides of the neck, the incision was made beneath the jaw from below the angle on one side to a similar position on the other. In five cases a more radical neck dissection was done than that described above, with the removal of the internal jugular vein, the sternomastoid muscle, and the glands to the clavicle.

Palliative operations. What has been termed in this paper the palliative operation, that is, the removal of the growth from the lip without dissection of the glands of the neck, was performed 41 times. In 10 cases the growth was small, papillary in type, and might almost be termed precancerous. In 3 it was extensive and the operation was done to remove a sloughing tumor. In many of the remaining 28 cases, the age of the patient or his physical condition was a contra-indication to radical operation, but there was a small group in which, from the records, the reason for not removing the glands from the neck was not clear.

Operative mortality. There were three postoperative deaths in the series of 122 radical operations, an operative mortality of 2.5 per cent. There was one death from erysipelas and auricular fibrillation on the seventeenth day, one from sepsis and pneumonia on the tenth day, and one from probable pulmonary embolus on the second day. All of these patients were what might be termed poor surgical risks. One of the deaths occurred after the removal of the glands from one side of the neck, and two after dissection of both sides. There was no operative mortality following excision of the growth only.

Postoperative complications. In addition to the three postoperative deaths there were several cases of postoperative complications. All, with one exception, were due to some form of infection. There were 10 cases of serious sepsis, several of minor sepsis, and one case of phlebitis. One patient developed postoperative pneumonia and there were three cases of severe bronchitis. There was one case of severe postoperative hæmorrhage, probably due to the slipping of the ligature on the facial artery, which necessitated packing of the wound. All of these patients eventually made satisfactory recoveries.

Plastic operations. In 16 cases in which the growth was extensive it was found impossible to close the defect in the lip in the usual manner without tension or without making the oral opening too small. Some form of plastic operation was performed on these cases to remedy the defect. The cases have been grouped separately as the extent of the local lesion had a distinct relation to the prognosis. Thus of the 14 cases in this group that have been traced, 10 have died of a recurrence of the disease, while only 4 (28.3 per cent) are living and well.

SECONDARY OPERATIONS

Secondary operations for local recurrence of the disease were performed twice and both of these patients are well three or more years after the second operation. A new cancer (re-occurrence) formed at another point on the lip and was removed in two other cases. Both patients are also well three or more years after the second operation.

In seven cases in which the neck had previously been dissected, a second extensive dissection was performed for recurrence. All of these patients are dead; two as a result of the operation, and five of the disease.

RESULTS

There were 122 cases in which an attempt at cure by a radical operation was made. In 73 the local growth was excised and the glands dissected from one side of the neck, and in 49 the glands were removed from both sides of the neck. Dissection of both sides of the neck usually implied that the growth was extensive or situated in the center of the lip.

The results are about what might be expected in a series of consecutive cases in a large general hospital. Of the 122 cases the end-result is known in 103, but in 5 cases the data are inconclusive, the patients having died of some other disease within the three-year limit without recurrence. Of the remaining 98 cases, 68 are living and well without evidence of the disease, or have died of other cause more than three years after operation, while 30 are dead; 27 from a recurrence of the disease and 3 as a result of the operation. This gives 68.1 per cent cures following the radical operation.

RADICAL OPERATIONS

Total cases	122
End-results known	103
Inconclusive	5
Postoperative deaths	3
Died of recurrence	27
Living without disease 3 years or more	68
Percentage 3-year cures	68.1

If these cases are separated into two groups, Group 1 being those cases in which the glands from one side of the neck were removed, and Group 2 being those in which the glands were removed from both sides of the neck, it is seen that the percentage of cures in Group 1 is larger than in Group 2. This implies only that the extent of the local disease bore a direct relation to the prognosis, as the double dissection was usually done in the more advanced cases. The relation of the size of the growth on the lip to the prognosis is also shown by the small percentage of cures in the group of cases requiring a plastic operation to close the defect after excision of the growth. Thus in 14 traced cases in which the wound of the lip could be closed only by employing some form of plastic operation, but 4 (28.3 per cent) are living and well.

RADICAL OPERATIONS

	Dissection glands one side of neck	Dissection glands both sides of neck
Total operations	73	49
End-results known	64	39
Inconclusive	3	2
Postoperative deaths	1	2
Died of recurrence	13	14
Three-year cures	47	21
	(77 per cent)	(54 per cent)

The percentage of cures in the cases in which metastatic cancer was demonstrated in the glands removed was much smaller than in the cases in which no metastases were found. In 19 traced cases in which the glands were involved by the disease, 5 are well (27.7 per cent), while in the 72 conclusive traced cases in which no cancer was found in the glands, 63 are well (86.6 per cent). The radical operation would seem to be justified if 27.7 per cent of the cases with known metastases are cured.

RESULTS—METASTATIC GLANDS

	Cancer in glands	No cancer in glands
Total cases	24	92
Untraced	4	9
End-results known	20	79
Inconclusive	0	4
Postoperative deaths	1	2
Died of recurrence	14	9
Three-year cures	5	63
	(27.7 per cent)	(86.6 per cent)

The site of recurrence could not be determined in many of the cases. We have no evidence of general metastasis in any case but the data are not conclusive as the facts in regard to patients dying of recurrence were usually obtained either from letters from friends or relatives, or from the death certificates on file at the Bureau of Vital Statistics at the State House. In the only patient dying of recurrence on whom an autopsy was performed, there was local recurrence only. As well as could be determined the site of recurrence was as follows:

SITE OF RECURRENCE—RADICAL OPERATION

In neck only	13
Neck and local	5
Local only	4
Undertermined	5

In one case in which the glands were removed from one side of the neck the first evidence of

recurrence appeared in the glands of the opposite side.

Palliative operations (local excision only). There were 41 cases in this group operated upon without mortality. In ten instances the tumor was small and although pathologically cancer, it might well be considered clinically as precancerous. Eight of these cases have been followed and all were cured. Three cases were obviously palliative operations as the growth was large and a plastic operation was necessary to close the wound. Two of these cases have since died with both local and glandular recurrence and the third has not been traced. Of the remaining 28 cases, five are inconclusive or have not been traced and 11 have died of recurrence. Twelve (60.6 per cent) are living or have died of disease other than cancer more than three years from the date of operation. In most of these cases the radical operation was contraindicated on account of the physical condition or age of the patient.

Taking the "palliative" operations as a group, the figures are as follows:

RESULTS—LOCAL EXCISION ONLY

Total cases	41
End results known	35
Inconclusive	2
Died of recurrence	13
Three-year cures	20 (60.6 per cent)

Of the 13 cases dying of a return of the disease, the site of the recurrence is known in 9. In 4 cases the recurrence was in the glands of the neck only, in 4 it was both glandular and local, and in 1 it was local only. If 27 per cent of the cases in which metastatic cancer is demonstrable in the glands removed from the neck are cured by a radical operation, it is presumable that a certain number of cases in this group would have been cured if the more extensive operation had been performed.

The average length of life of all cases dying of recurrence from the date of operation was approximately two years (23.3 months). In cases in which the glands removed at operation showed cancer, the length of life was slightly shorter than the average (21.7 months). With one exception in all cases dying of the disease the recurrence or death occurred within the three-year limit. One case died of glandular recurrence 7 years after the primary operation. The history of this case is as follows:

In 1898 a cancer of the lip was removed and the glands dissected from the corresponding side of the neck. In 1914 a re-occurrence was removed from the other side of the lip but the neck not dissected. In 1921, seven years later or 23 years after the first operation, he re-entered the hospital with a glandular recurrence in the side of the neck that had not been operated upon. A radical neck dissection was done, but the patient died of the disease 8 months later.

CANCER OF THE LIP—RESULTS

Total cases	187
Recurrent cases	15
Cases available for study of mortality, etc.	172
Radical operations	122
"Palliative" operations (local excision)	41
No operation (not advised 5, refused 4)	9
Mortality, radical operations (2.5 per cent)	3
Mortality, "palliative" operations	0
Inconclusive cases	
No pathological report	1
Died without recurrence less than 3 years	6
Untraced	27
Cases available for end-result data	131
Radical operations	98
"Palliative" operations	33
Cases alive and well	78
Cases died without recurrence over 3 years	10
Number 3-year cures, all operations	88
Number 3-year cures, radical operations (68.1 per cent)	68
Number 3-year cures, "palliative" operations (60.6 per cent)	20
	Per cent
Cures, radical operations, glands cancerous	27.7
Cures, radical operations, glands not cancerous	86.6
Cures, radical operations, one side neck dissected	78.5
Cures, radical operations, both sides neck dissected	56.8
Cures when plastic closure necessary	28.3

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RESUSCITATION, INTRACARDIAC INJECTIONS

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THIS paper is based upon observations made during three and one-half years of active surgical service in the British Army in Belgium, France, and Great Britain during which time the author performed upward of 5,000 operations under chloroform, ether or spinal anæsthesia, and upon observations made in the clinics of his chief, Professor A. J. Ochsner, at the Augustana and at St. Mary's of Nazareth Hospitals, Chicago.

It was very noticeable during the Great War that patients who had suffered from severe hæmorrhage did not tolerate grave operations under spinal anæsthesia, several deaths occurring in this class of patients. However, it is doubtful whether these seriously wounded cases could have survived under any other anæsthetic unless it had been nitrous oxide and oxygen.

This same class of patients, after transfusion with blood in sufficient volume (700 to 1200 cubic centimeters), could be given spinal anæsthesia with entire safety. This fact would seem to argue that, when collapse occurs under spinal anæsthesia, it is due to the lowering of an already low blood pressure by the engorgement of the arteries (as well as the veins) of the anæsthetized part of the body, due to muscular relaxation combined with a general relaxation of the entire body, thus removing the muscular tone so important in insuring the venous return from the limbs.

Bearing in mind these considerations as well as the work of George W. Crile upon "Anæmia and Resuscitation," the author employed adrenalin resuscitation in five cases with immediate success in each case and with permanent success in two cases after failures by ordinary methods.

The first case was seen at No. 17 Casualty Clearing Station near Ypres in Belgium in 1917. During the terrible rush of work following the British onslaught on Paschendale Ridge, it was sometimes necessary for a surgeon to operate so fast that the anæsthetist had to keep three patients under chloroform anæsthesia simultaneously; inducing anæsthesia for one, maintaining surgical anæsthesia for the second, and allowing the third to recover while orderly applied bandage or splint.

Case 1. The patient under discussion, a young enemy soldier, had been anæsthetized with chloroform and resection of the lower lobe of the lung was being done for gangrene. The left chest was open and a suture-ligature had been placed about the lung proximal to the gangrenous portion and was tied. While resecting the lobe it was noticed that the heart became irregular and stopped shortly. I made direct manual massage, compressing the ventricles and allowing them to expand until the heart beat again rhythmically but without full systole. It quickly ceased to beat again when direct massage was of no avail except to elicit an infrequent and incomplete systole. I then stimulated the myocardium with the point of a scalpel, a few contractions following each prick but soon nothing but fibrillary twitching resulted. Respiration had ceased and artificial respiration was being done, my fist closing the parietal wound in the chest. Artificial respiration and cardiac massage was continued for perhaps 15 minutes after final cardiac failure. Oxygen gas was administered to no avail.

I then procured a large 20 cubic centimeter Luer syringe and injected directly into the left ventricular cavity about 10 cubic centimeters of adrenalin 1:1000. I gave the heart a squeeze and it began to beat, firmly and with far greater vigor than I had yet noted. Artificial respiration was recommenced and continued for about 20 minutes during which time no respiratory effort was made. A tracheotomy was then made and a catheter introduced into the right bronchus. A tank of oxygen was attached to the catheter and sufficient pressure allowed to inflate moderately the right lung. The respiratory exchange was sufficient to keep the patient's color a healthy pink—better than it had been before his operation as he was deeply cyanosed, due to the pneumothorax and pulmonary gangrene. After about 25 minutes from the intraventricular injection of adrenalin, the heart again began to fail by dropped beats and failure to make complete systole. Another injection of about 10 cubic centimeters of adrenalin was given intraventricularly. The result was a return to full systole and regularity with increased frequency in rate. During all this time (estimated at about 40 minutes) *there had been no respiratory movement.* After about 40 or 45 minutes the patient began to breathe, making very feeble inspiratory movements

at long intervals. The depth of respiration gradually increased and the rate improved until about 50 minutes after the initial cardiac and respiratory failure he began to breathe of his own automaticity. The catheter was removed from the trachea and bronchus but oxygen was still supplied. The patient continued to breathe and the heart to beat for about 25 minutes more when the supply of oxygen failed. He then became cyanosed and the heart beat weakened somewhat. At this time a prisoner of war was found who volunteered to be donor for the transfusion of blood. Six hundred cubic centimeters of blood was transfused slowly into the median basilic vein of the patient and within a minute afterward the heart (which I held in my hand) dilated, fibrillated and ceased to beat.

It is interesting to note the fact that respiratory impulse did not return for a long time and that, although ample time elapsed and respiratory exchange was sufficient for the disappearance of chloroform narcosis (which was never profound) consciousness never returned. This fact bears out G. W. Crile's statement that ischæmia of the higher cerebral centers in dogs which persists more than 10 minutes seldom is followed by recovery of function. Therefore, even though it had been possible to continue the resuscitation of this patient it is practically certain that no psychical function ever would have returned.

To recapitulate: 1. Cardiac and respiratory failure due to chloroform and shock;

2. *Direct* cardiac massage and stimulation combined with artificial respiration failed to resuscitate;

3. Intraventricular adrenalin (after at least 15 minutes of complete cardiac failure) resuscitated cardiac function;

4. Respiration returned after 45 minutes.

Case 2. Patient undergoing amputation in the hands of one of my colleagues. When first seen spinal anæsthesia had been induced, the injection having been made in the usual manner 8 minutes before. Anæsthesia had resulted, the amputation had begun and progressed to the point of skin dissection, when the patient showed signs of collapse.

When called to see the case, the respirations had ceased but the heart was beating slowly, each beat following its predecessor more slowly. The force of the beats was good, the contractions of the heart apparently being efficient and forceful, the intervals being progressively lengthened. No pulse was palpable at the wrist. The eyeballs were rolled upward and to all appearances the patient was moribund. He was observed for perhaps 30 seconds, the amputation meanwhile progressing.

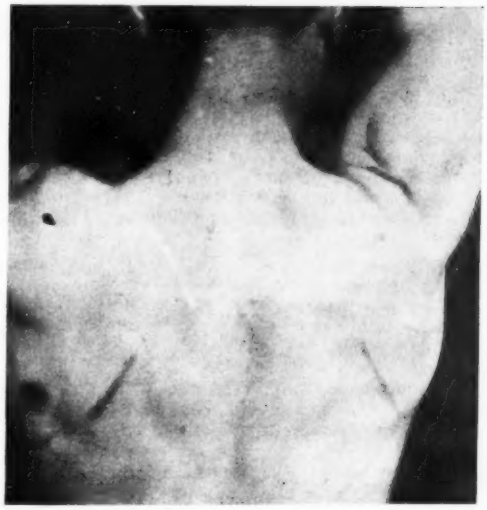

Fig. 1. Back view of Case 4 about a month after resuscitation to show abduction of arm by scapular rotation.

Artificial respiration was done, the heart rate continuing to decrease as was noted by palpation of the *femoral* artery at Poupart's ligament.

The amputation was completed but abandoned without ligature of the vessels or suture of the skin flaps since the case seemed hopeless. During the operation intravenous infusion of normal saline solution had been done and the cannula was in place in the right basilic vein. The heart gradually ceased to beat, during which time no respiratory impulse occurred. During a period estimated at between 5 and 8 minutes following the last audible or palpable heart beat, attempts to resuscitate the man were made by artificial respiration and thoracic and epigastric massage without avail. At the end of this time I injected 20 cubic centimeters of adrenalin hydrochloride into the rubber tubing of the infusion apparatus near the cannula and the adrenalin solution was washed into the venous system by a flow of saline solution. Vigorous, heavy, epigastric massage was done.

The heart at once began to beat, respiration shortly began, and before one had time to realize the fact, the vital mechanism was once more in action. So vigorous was the response that alarming hæmorrhage occurred from the cut end of the femoral artery; the tourniquet not having been removed. There had been no hæmorrhage during the operation, thus showing that the adrenalin injection had raised the blood pressure considerably above what it had been before apparent death. The vessels were ligated and the patient returned to his ward where he made a perfect immediate recovery but died three days later of sepsis.

CASE 3 was that of a young soldier of nineteen years who had suffered a shattering wound of his knee joint, which had to be amputated by reason of secondary hæmorrhage and sepsis combined.

The hæmorrhage was from the popliteal artery but was not severe in itself since the nurse on duty had applied a tourniquet at its inception. Stovaine was given intrathecally in the usual way. The operation was begun about 6 minutes later. Collapse occurred while the skin incision was being made. The patient complained of nausea, the face became pallid, the patient vomited and became perturbed, the respiration quickly failed, the eyeballs rolled upward, and the heart rate steadily became slower until it ceased. Its force was maintained until cessation occurred as in Case 2. Meanwhile, artificial respiration was done, traction was made on the tongue and the usual procedures during such times were carried out. After an interval of perhaps 4 to 8 minutes a 10 cubic centimeter syringe was obtained, and adrenalin hydrochloride 1:1000 was pumped into the basilic vein—as much as 10 cubic centimeters being injected into the vein.

The adrenalin solution was washed in by saline solution and vigorous massage of the heart was done from the exterior. Pulsation began and at once became vigorous. Respiration and consciousness returned, and the amputation was carried to completion under the original anæsthetic. Apparently blood pressure was very high for about 2 hours.

The stump healed without incident and the patient was evacuated to England after 3 weeks, in good condition and is believed to be alive today.

CASE 4. A case of suspended animation, due in this instance to chloroform poisoning, was that of a soldier of about 35 years, who was to be operated on for the removal of a small sequestrum from the neck of the humerus. The sequestrum was embedded in an involcrum at the site of fracture, a sinus having persisted for about a year. The patient was in every other respect in normal health. A chloroform anæsthetic was administered in the anæsthetizing room. On examination when brought into the operating room I discovered that his face was livid and that breathing had ceased. The head of the table was immediately lowered, artificial respiration was done, and we satisfied ourselves that there was no obstruction in his breathing. It was at least 5 minutes before a needle and syringe were brought, when two doses of 5 cubic centimeters of adrenalin (1:1000) were injected directly into the heart by puncture in the fourth intercostal space about an inch from the midline close to the sternal margin, thus avoiding the internal mammary artery. An ordinary lumbar puncture needle was used. There was immediate response, the heart beat at once and respiration followed very shortly. The anæsthetic remained deep enough for the operation to be performed without further administration of chloroform and the patient was returned to his ward 5 minutes later. There was some lack of mentality and confusion for the remainder of the day, but the patient did not complain of any abnormal symptom. At 2 a.m. the following morning the patient awoke, complaining of severe pain in the cardiac region; he was very restless and had some dyspnœa and there was irregularity of the pulse. Oxygen inhalations were administered, after which the patient slept for the remainder of the night, the attack having lasted for about 20 minutes. At 8 a.m. he recited his symptoms to me, still complaining of some pain in the precordial region. There was at that time no irregularity in the pulse. The subsequent day and night were without event, but the next day there was again a slight attack of anginal distress with slight irregularity of the pulse but without dyspnœa or fainting. From this time onward the patient made an uneventful recovery, and when seen 6 months later, was in normal health and doing manual labor, his wound having healed by primary union. He had never been told of his extraordinary experience, so that the attacks could not have been the result of hysteria but must have been due to some irregularity of the heart as a reaction after its unusual treatment. Neither of these patients who survived showed any abnormality which could be attributed to their 6 or 7 minutes of absolute cardiac failure.

CASE 5 was a patient of my chief, Professor A. J. Ochsner. A man of 72 years was given spinal anæsthesia for the removal of the prostate gland. Cardiac and respiratory failure occurred after about 20 minutes. No heart beat was palpable, no pulse could be felt, no heart sound could be heard. Artificial respiration was done combined with extrathoracic cardiac massage for a period of about 15 or 20 minutes. During this time I had made several attempts to puncture the heart, but was not able to aspirate blood, which one does to prove that the heart cavity has been reached before making the injection. I then discovered that the spinal needle which had been used was plugged. Procuring a new needle the intracardiac injection of about 5 cubic centimeters of adrenalin was made and epigastric massage was done. The heart beat faintly at first but stronger and stronger until the radial pulse became full, hard, and regular. Artificial respiration was continued and after a while a few respiratory efforts were made. However, the heart gradually failed again after perhaps 25 minutes and nothing further was done. It is possible that had the intracardiac injection been made within the first 5 minutes, rather than after 20 minutes of complete cardiac failure, the patient might have recovered.

It would seem that the dosage of adrenalin, as used in the first cases, was rather large, and it might be that smaller doses would accomplish the same results, but one can never be sure that a small dose will reach the heart and this appears to be essential to the success of the treatment.

In the fourth case, where the adrenalin was

administered directly into the heart, 10 cubic centimeters seems to have been sufficient. In direct administration, however, there is always a possibility that the adrenalin will not reach the heart itself but will remain in the heart muscle. Also it generally requires a longer period of time to procure the long spinal needle necessary for intracardiac injection and the adrenalin cannot be washed into the circulatory system with a saline infusion as is possible if it is injected into the vein.

On the other hand, when the vein is not already exposed for infusion and when the blood pressure is very low or when no pressure exists, it is often difficult to enter the vein; and where speed is essential, it is quicker to inject directly into the heart. I do not know whether massage is essential to the instigation of the heart beat, since it was done at once in all cases without waiting to see if adrenalin alone were sufficient.

The mode of action in this treatment is presumably the same as adrenalin exhibits ordinarily. On reaching the heart auricle or ventricle, a forcible contraction occurs, emptying the auricular content into the ventricle, which then contracts (by the adrenalin action), filling the coronary arteries and expelling the ventricular contents into the aorta where the adrenalin again acts, and thus arterial tension is developed. It may be, too, that the first auricular contraction regurgitates adrenalized blood into the great veins, contracting them and thus filling the auricle in its diastole.

The cycle having been thus established, each subsequent contraction pushes the adrenalized blood further into the arterial system, increasing tension as it progresses and soon reviving the cerebral circulation and the respiratory center. One should make the injection as quickly as possible so as to revive the cerebral circulation since after an ischæmia of more than 8 to 10 minutes the higher centers may be permanently destroyed.

Adrenalin (1:1000), a sterile spinal puncture needle, and a large glass syringe would be valuable additions to every operating room.

NOTE.—Since writing the above paper several articles have appeared dealing with the subject, all of which concur in the general principles involved

Walter Greuel (1) recommends the intracardiac injection and reports 4 cases and states that he has found reports of 100 cases in the literature with 13 permanent successes. He recommends the use of intravenous glucose solutions in conjunction with intracardiac adrenalin injections.

Gerold Kneier (2) reports 2 cases, one of which lived for 18 days afterward. He states that a permanent result can not be expected in cases in which the cause of apparent death cannot be removed quickly and sets a time limit of 3 minutes which we believe to be very conservative as several of our cases experienced longer intervals of apparent death.

Emil Vogt (3) describes a technique for making the injection with an excellent theoretical discussion of the minute anatomy of the heart.

Franz Schmidt (4) describes a method and suggests that large doses of adrenalin may cause fibrillation. He has also employed strophanthin (0.2-0.5 mg.) and caffein (20-40 cg.) and tonozen (0.1-0.2 c.cm.), but he calls adrenalin the sovereign agent.

All of the reports call attention to the fact that a long needle must be employed, that heart blood should be aspirated to prove entrance into the heart cavity, that speed is very important, and that the massage of the heart should be made; in which we concur.

Several authors describe relatively minute dangers and discuss the nodes and bundles of the heart which we consider purely academic in importance and secondary to the all-important act of speedily injecting adrenalin into the heart cavity, let it be auricle or ventricle. Probably the left side of the heart is the better site since the pulmonary circulation does not then receive the adrenalinized blood directly.

It seems that the dose should be sufficient to insure the entrance of adrenalin into the heart cavity; that 1 cubic centimeter may be sufficient as recommended by Kneier or even only a few drops as recommended by Vogt. It is also worth while to know that 10 cubic centimeters can be used successfully in adults and we suggest a dose of from 1 to 10 cubic centimeters depending upon attendant conditions of time elapsed since cardiac failure, age of patient, size of patient, quality of adrenalin, and cause of apparent death. We do not recommend this procedure as a substitute for present resuscitation measures but advise its use only after ordinary means have failed.

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FORWARD DISLOCATION OF BOTH BONES OF THE FOREARM AT THE ELBOW

Review of the Recorded Cases and the Literature with Report of Case

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THE case under discussion is of such rare type, that it seems worthy of report with a complete review of the literature. Since Evers first reported a case in 1787, 22 cases have been recorded in the literature, and the present case brings the total reported to date to 23.

In chronological order, the authors reporting cases may be listed as follows: Evers, 1787; Colson, 1818; Leva d'Auvers, 1842; James Prior, 1844; Monin de Mora, 1846; Guyot, 1847; Wittlinger, 1848. With the exception of the case of James Prior, the other 6 were collected in the epoch-making review of Streubel in 1850. Since that time, individual case reports have been made by Ancèlon, 1859; Secrestan, 1860; Canton, 1860; Caussin, 1861; Hutchison, 1866; Fulton, 1897; Platt, 1899; Staunton, 1905; and Isidore Cohn, 1922.

Beside these uncomplicated, forward dislocations, 7 cases of forward dislocations in association with fractures of the olecranon or coronoid have been recorded, in chronological order, as follows: Richet from Boyer's clinic, 1839; Morel-Lavalée, 1858; Richet, 1859; Rigaud, 1870; Mons, 1877; Stimson, 1899; and Batut, 1910.

REVIEW OF THE LITERATURE

Since the first report by Evers, the literature on this subject has been full of contradictions and denials. Other reviewers of this subject, notably Streubel, have been unable to gain access to the original report[1] of this case; for this reason, I believe it of value to record a translation from the original. The translation follows:

Observations on an Afterward Complicated Dislocation of the Cubitum with no Break in the Olecranon

1785 July. A seven year old boy with weak muscles fell from a swing at a considerable height on to his right arm, so that the lowest extremity of the upper arm directly above the olecranon was struck from behind against a large stone.

The cross wound was 3 inches long, with no hæmorrhage — it was directly in the bend of the right arm and out of it were hanging lacerated shreds of aponeuroses, tendons, blood vessels, and nerves. The lower extremity of the humerus projected 2 good inches from the wound, and by the still active force of the muscles the unbroken olecranon had been pushed up above. (See *Treatise on Diseases of the Bone.* M. Petit. Paris, v, 1, p. 232.)

The active force of the fall against the stone was so great that the lower extremity of the upper arm was thrust forward, not only completely dislocated, but as already remarked all the surrounding deep-seated parts were torn from the fracture. I easily and quickly effected the replacing of this luxation. I raised the upper arm as far as possible and extended the forearm at a right angle with the upper arm, and as I thought the necessary extension and contraction had been sufficiently effected I bound the forearm to the upper arm at an acute angle. I did not cut the shreds of aponeuroses, tendons, blood-vessels and nerves hanging from the wound, for fear of fresh hæmorrhage, but left them to detach themselves by ulceration through the subsequent suppuration.

The wound was bound up dry and the necessary compresses were strengthened by a circular bandage. This remained 4 days and as often as it became dry it was moistened with water and wine vinegar in which sal ammoniac was dissolved, and the arm placed in the napkin.

The pulse in the injured arm was not so much increased as it very often is after the operation for false aneurism, but it was more rapid than in a sound person. The much swollen hand was cold rather than warm and, with all the loss of blood, the inflammation and suppuration increased nevertheless.

On the fourth day I had to change the treatment for emollients whereby the necessary suppuration would be hastened, which, as is known, is not great in any aponeurotic injuries.

In the best condition of the arm I could not induce free flow of pus which was hindered by the unusual inflammation and swelling in the bones, while the accumulated and stagnant pus in the joint caused an abscess on the outer condyle of the humerus. After the abscess opened, so that the pus had free outlet, there was consequent pain and fever, and the extreme inflammation and swelling of the bones themselves became very sensible.

[1] Loc. cit. p. 22.

I tried to keep down the suppuration by the continued use of an emollient and the resisting ulceration, but I could not hinder the effect of the great contusion of the under end of the humerus; while during the 10 or 12 weeks of the treatment the whole exterior condyle flaked off leaving a perceptible hole, without any special effect being observable.

From time to time I permitted the arm to move to prevent anchylosis, and for the extraordinary bone swelling I used a mercurial unguent without terebinth with very good results.

By this treatment this very interesting injury and likewise the severe bone swelling and the lacerated ligaments, tendons, blood vessels, and nerves which prevented the free movement of the elbow joints, was fully healed in the course of not quite 4 months.

But the usual sensation of warmth and the pulse in the injured arm were still feeble and the cold hand bent itself inward when left free. I therefore let the blood-filled or collapsed vessels enlarge and the influence of moisture in itself limber the entire arm, by bathing frequently with warm soapy water, and while the boy was bathing he moved the arm and hand more freely and the pulse increased.

By this treatment of warm baths the pulse increased more and more and strength in the same degree, as also the feeling of warmth and the free movement of the injured arm, so that the patient was completely cured of this remarkable injury in 5 months.[1]

Boyer (1822) stated: "We have never seen an anterior dislocation of the elbow complicated by a fracture of the olecranon process, and we doubt, though it is possible, if it has ever been seen." He further states: "It is possible that the upper extremity of the forearm can be displaced, backward, forward, or to either side; but, the first one is the only one that has been seen. As to forward dislocation, *it can occur only after the olecranon process has been fractured.*" (Italics mine.)

Sir Astley Cooper in 1832, mentions only five species of dislocations of the elbow. "Firstly, both bones are dislocated backward; secondly, both are dislocated laterally; thirdly, the ulna is dislocated separately from the radius; fourthly, the radius is dislocated forward; fifthly, the radius is dislocated backward." No mention whatever is made of the possibility of a forward dislocation of both bones of the forearm, either with or without a complicating fracture.

[1] Access to this volume was obtained through the courtesy of Surgeon General's Library. The translation was done by Miss Spofford.

Monteggia (1825), whose work is referred to by Canton and Streubel, "is inclined to believe in the possibility of a forward dislocation without fracture of the olecranon, but maintains that it can occur only where there is a considerable pathological relaxation of the ligaments." (Streubel.)

Delpech "talks of a case of forward dislocation without fracture of the olecranon, but we are not informed if he or someone else has seen this case. . . . He adds in explanation that in this case the soft parts have been so torn and contused, that it would be better to overlook this kind of luxation altogether, and to consider it as entirely non-existent." (Streubel.)

Bérard considers "Forward dislocation without fracture of the olecranon inconceivable . . . and assumes the one with fracture is only theoretically possible, but by no means practically demonstrated." (Streubel.)

Richet (1839) quotes from Lauson: "The anterior dislocation of the two bones of the forearm on the arm, that is to say, complicated by a fracture of the olecranon, has been more theoretical, than practical." He also quotes Bérard as follows: "As to the anterior dislocation, complicated by a fracture of the olecranon it is, I think, only from theory that surgeons have been able to describe it, for I have not found one instance in which this accident has been mentioned."

Malgaigne (1823) does not mention the condition at all.

Cheluis (quotation from Richet) admits that "the anterior dislocation of the elbow is possible, but does not describe it in his chapter on luxations or fractures."

Gross in 1859 stated: "Dislocations of both bones of the forearm forward is an extremely rare event, which was supposed to be altogether impossible, without previous fracture of the olecranon, or extensive laceration of the soft parts. Modern observation, however, has shown the fallacy of this opinion, by adducing a number of unequivocal cases in which the displacement existed as a pure, uncomplicated affection." Gross mentions a case of Forbes, of Philadelphia, and another of Hunt, of Chicago, of which I have not been able to find records.

CASE REPORTS

Streubel (1850) collected all of the reported cases, with the exception of that of James Prior and from this work of Streubel's, I shall take the liberty of quoting rather freely, and recording cases in the words of Streubel. One can easily see, from the expressions quoted from the literature, that surgeons prior to 1850 were not convinced that forward dislocation was even possible, and yet at that time, Streubel was able to collect the following six cases:

CASE 1. Forward dislocation of the bones of the forearm without fracture of the olecranon. The first example of such a displacement was observed and described by Evers in 1787; unfortunately, we were not able to get a copy of his book and are therefore unable to judge his case critically.

CASE 2. Colson[1] observed a second case toward the end of the year 1818. He describes it as follows: "A fifteen year old boy, pale and emaciated, but in good health, fell while skating, with the whole weight of his body on the elbow of his right half-flexed arm. The power of the fall had been concentrated on the olecranon, with the result that it was separated from the trochlea and had slipped forward. On examination not long after the injury, the arm was found to be almost an inch longer, the point of the olecranon stood on the lower surface of the trochlea humeri, and the movements of the very slightly flexed arm were rather restricted. It was easy to get the arm in forced extension (hyperextension), but on flexion, strong resistance was soon met, and the injured boy suffered great pain. Each movement caused the point of the olecranon to move about on the trochlea. The radius had remained firmly fixed to the ulna. Reduction was easily accomplished by extension and pushing the upper end of the forearm backward." We are not told if the patient regained the full use of his arm.

CASE 3. Reported by Leva d'Auvers and quoted by Streubel is in some respects described more in detail than the case of Colson:

"A severe fall on the elbow of the flexed arm was followed by loss of use, with elongation of 1 inch; the olecranon was not on the posterior aspect of the joint, the arm was lightly flexed. The soft parts covering the joint were under high tension. The biceps tendon appeared as a raised cord anteriorly, the sides of the elbow joint were flattened, depressed, and especially posteriorly, there were grooves, corresponding to the altered surfaces of the joint. Below arose the coronoid process of the ulna beyond the biceps tendon, and below it, the sigmoid cavity could be felt. On the upper side of the posterior aspect of the joint, the ends of the bone of the upper arm protruded as two rounded knobs, enclosing a depression, the fossa olecranon. The movements of the arm were very restricted and extremely painful."

[1] Quoted by Huguier. These de concours, Par., 1842, p. 46.

Leva reduced it by letting one assistant make counter extension at the shoulder, while a second extended the forearm. He then pushed the ulna forcibly backward, while he pulled the end of the humerus forward. Reduction occurred after a short time with an audible snap. Leva has forgotten to mention if the arm became partly or entirely useful again.

CASE 4. Reported by Monin de Mornant offers several peculiarities which distinguish it essentially from the examples so far cited. "A boy between 6 and 7 years old, had fallen from a rather high wall upon a dumpheap. His arm had been strongly flexed with the elbow pushed out forward. Thus the olecranon was placed almost parallel with the condyles of the humerus. The force of the fall met first the olecranon, pushed it upward and fixed it, so to say, while the lower end of the humerus, pushed obliquely forward and downward by the weight of the body, slipped under and behind the olecranon. The soft character of the material on which the boy had fallen, prevented a fracture of the bones."

In this case, the olecranon stood not upon the trochlea, but lay in front and partly over it. The arm appeared shortened, and the anteroposterior diameter of the joint was considerably lengthened, the arm was slightly flexed, could be extended and also a little further flexed. Monin tried several times to restore the dislocated arm by repeated extension and counter extension, when he remembered how the displacement had occurred with the arm strongly flexed. He now arranged his reduction technique as follows: He let one assistant fix the upper arm at the shoulder, bent the forearm forcibly, causing severe pain to the patient, and gave it to a second assistant to hold in this position. Then he crossed both hands over the bend of the elbow and tried to push the upper ends of the bones of the forearm downward and backward, while both assistants pulled. The point of the olecranon was thus put into a very oblique position toward the trochlea and could be made to slip over it without obstacle. Reduction now occurred very quickly. The subsequent inflammation was quite moderate and after one month, the patient had complete freedom of motion.

CASE 5. Reported by Guyot, at Norges. "A fourteen year old boy had been thrown with great force from a wagon, which had turned over, and fallen on the elbow. The arm became useless immediately. The writer examined the patient after 3 hours. The arm was lengthened by 1 inch, the region of the elbow showed some swelling and the forearm formed a straight line with the upper arm. On the posterior aspect of the joint, a depression was felt in place of the olecranon; anteriorly, there were two eminences, which were also marked on the skin by two round red spots, then followed a groove and

below this, lay the head of the radius exteriorly and the coronoid process with its margins on the inside. The forearm was unusually mobile and could be flexed backward and forward, and even laterally. Reduction was extremely easy, only slight extension and backward pressure on the upper end of the forearm was necessary." Information is not given as to course after reduction and healing.

CASE 6. Reported by Wittlinger. "While exercising in the gymnasium, a young man 18 years old, fell with full force on the forearm and elbow of the right arm, which was flexed and pushed forward. During examination, the writer found both bones of the forearm on the anterior surface of the bone; but the olecranon was missing from the posterior fossa of the joints. The articular surface of the humerus with the two condyles, stood on the posterior surface of the bones of the forearm and formed a marked eminence; the arm itself was almost extended."

This rather short description shows at least that, as in the case of Monin, the olecranon had slipped across the entire surface of the trochlea and was lying with the posterior surface of its base on the highest point of the trochlea. The writer believes that the displacement occurred primarily backward and outward and developed secondarily into an anterior dislocation by the olecranon slipping over the external condyle. To reduce, the writer followed his views of the mechanism rotating the forearm outward and then pulling it across the external condyle. This procedure he reports to have been quite easy. After reduction, he surrounded the joint with figure-of-eight bandages, and for 6 days applied cold applications of lead water with ammonia. From the seventh day on, lukewarm aromatic fomentations were ordered and every day, careful movements were made; later on inunctions of gray ointment, volatile liniment, and finally came animal baths. (?) Almost complete function was restored, except that the arm could not be completely extended. A little swelling had remained over the olecranon and the internal condyle."

CASE 7. Reported by James Prior in 1844. Chronologically considered, this case should be placed as the fourth recorded case. Collectively, it is the seventh case found in the search of the literature. The details of the case, as reported by the author, are as follows:

"A laborer, age 34, was winding a weight of some tons by means of a crane when the chain suddenly broke. The handle of the machine was made to revolve violently the reverse way, and struck him on the under side of the left arm at the elbow. Examination showed a large wound on the under surface of the joint, occasioning a general disconnection of the parts, muscular and otherwise, except immediately in front. All of the ligaments were torn. The heads of the radius and the ulna were driven upward on the humerus. The lower end of the shaft of the humerus was denuded of the muscle and ligamentous attachment. Final result: Patient could swing a sledge hammer, weight of 14 pounds."

CASE 8. Reported by Ancèlon in 1859. Anterior dislocation of the elbow. "A boy 8 years of age, while skating on the ice, fell on his left forearm, which was flexed on the arm. Twenty-four hours later, he was seen by a physician, who noted the following: The injured arm hangs by the side; the hand is held in pronation; the elbow is very painful, greatly swollen and movable; all its movements are associated with crepitus. Posteriorly, where the tumefaction is less evident, a depression is noted. The olecranon process cannot be felt at this point. Ancelon was called in consultation the following day, and as the swelling had subsided, he easily recognized that the injured limb was 3 centimeters longer. He also noted the crepitus and mobility, which had been found the previous day. On palpation, it was found that the depression on the posterior aspect of the arm was limited above by the trochlear process and below the olecranon, whose tip rested on the medial aspect of the trochlear process. When the forearm was on the arm to a right angle, it was found that the olecranon formed the point of the elbow 2 centimeters anterior to where it is usually formed. Ancelon diagnosed an anterioi dislocation of the elbow, without a fracture of the olecranon. The reduction was accomplished by making traction on the forearm, counter traction on the arm, and then suddenly flexing the forearm. The displacement reoccurred, but was again reduced."

CASE 9. Reported by Caussin in 1861 (*L'Union médicale*). Anterior dislocation of the ulna without a fracture of the olecranon, but complicated by a fracture of both bones of the forearm. On April 19, 1861, Caussin was called to see a servant, 15 years of age, who, while trying to dislodge a sack, caught his blouse and hand in the belt of the fly wheel. There was a small lacerated wound on the dorsum of the hand; there was a fracture of the forearm at its middle third. The two fractures were at the same level. There was a deformity at the elbow and some swelling. A tentative diagnosis of an anterior dislocation of the forearm without a fracture of the olecranon was made. The posterior aspect of the elbow was flattened and the fingers could palpate the olecranon cavity. The edges of the lower extremity of the humerus, especially the internal condyle, formed a large prominence. The forearm was held in semi-flexion. Extension and flexion of the forearm were limited and painful. The olecranon could be felt. No crepitus was obtained, but the whole olecranon process was anterior.

The *forearm* of an attendant was placed transversely across the elbow; then, with sudden forced flexion of the forearm, the dislocation was reduced. On account of the existing fracture of both bones of the forearm, not sufficient traction could be made so as to effect reduction. Hence, the other method was used.

The olecranon was not fractured. All movements of the elbow joint were then normal. The forearm

and elbow were then immobilized. After 40 days, the patient was entirely cured.

CASE 10. Reported by Secrestan in 1860. "July 29, 1860, I was called to see a child 8 years old, who, following a fall on the elbow, complained of pain in the elbow and was unable to use it. The following was found: considerable tumefaction of the left elbow, shortening of the arm, lengthening of the forearm, a deep depression, on the posterior aspect was a solid, irregular, hard mass which was readily recognized as the superior extremity of the line of the forearm; the biceps and brachialis anticus muscles were elevated, the forearm was held in a semi-flexed position. The olecranon process was found in the fold of the elbow, on its posterior aspect. Crepitus was obtained. The olecranon was on a level with a plane passed through both condyles. Attempt at reduction was as follows: while extension was being made at the wrist and counter extension at the elbow, I tried to force the ulna backward, but even though considerable traction was made, the reduction was not accomplished." The forearm was then flexed to a right angle and while traction was made on the forearm and counter traction on the arm, the forearm was gradually hyperflexed. "A clicking sound was heard; immediately, I knew that my efforts had been crowned with success; I could feel the olecranon process posteriorly. The luxation had been reduced." The arm was immobilized for a few days and kept moist with lead water compresses. The swelling slowly disappeared, and after 25 days, the limb had regained its normal movements.

CASE 11. Reported by Canton in 1860. A case of dislocation of the ulna forward, at the elbow, without fracture of the olecranon process. The details of the case are of particular interest, because it became necessary to amputate the limb. A very careful description of the dissected specimen is reported by the author. The notes, as given by Canton in report of the case, follow:

"The following case came under my care in the Charing Cross Hospital. F. P., age 40, a somewhat short, slimly built, but muscular man, while driving in a light cart at the rate of 7 or 8 miles an hour, was thrown out, and instinctively extended his right hand to prevent injury to his head. The weight of the body, however, caused sudden and forcible flexion of the elbow, and at the same time, the forearm became twisted in under his chest. On rising, it was found that the elbow was considerably swollen, and the power of moving it entirely lost. When admitted into the hospital, the forearm was forcibly flexed and the hand supinated. The swelling, ecchymosis, and tension around the elbow were so great, that it was with difficulty that any of the more salient anatomical peculiarities of this part could be recognized as everything appeared, in every way, so disarranged. The skin covering the inner condyle was stretched to the utmost, and here, over a space about the size of a sixpence, it was injured to such a degree, that a compound state seemed to be momentarily threatened. The antero-posterior and lateral diameters of the joint were increased in extent, and the general swelling was so great as to present a circumference far beyond the normal size of this region. Externally, and somewhat anteriorly, the cup-like cavity of the radius could be indistinctly distinguished; internally, the condyle was unduly prominent; anteriorly, no particular point for diagnosis could be determined on, on account of the state of forcible flexion and great tumefaction there; posteriorly also, the swelling was very considerable, but below it, there existed a depression favoring the view that the ulna was broken immediately below its olecranon process. No median gutter, with lateral elevations to bound it, could be felt.

"Attempts were made to rectify the mal-adjustment, but without success. The efforts, however, could not be longer continued, for it was obvious that the injury already sustained by the soft parts was so extensive, the obstacles to be overcome so resistent, and the great likelihood incurred of rendering the case one of the compound kind, forbade further trial, and it was agreed, in consultation, to place the limb at rest on a splint, and to keep the parts cool with an arnica lotion. However, within the course of 48 hours the tumefaction became still greater. A large slough was forming on the inner side of the joint, and high constitutional irritation having set in, I was obliged to amputate the limb at a sufficient distance above the articulation.

"*Dissection.* A very careful examination of the elbow was made, under my superintendence, by my pupil, Mr. Edgar Browne, with the following results:

"*Bones.* The ulna was dislocated forward, so that the upper surface of its olecranon process became placed in front of the capitellum humeri and had thus assumed the position naturally occupied by the head of the radius during flexion of the forearm. The radius was supinated and maintained *in situ naturale*, as regards the ulna, by the coronary and interosseous ligaments being intact.

"*Ligaments.* Of the anterior ligament, the only part remaining at all perfect, was a shreddy portion about the center; all the rest of it had been torn through. The posterior, and both lateral ligaments were completely divided. The coronary and oblique ligaments were uninjured.

"*Muscles.* The triceps extensor was detached from all of its points of insertion. The supinator radii longus was uninterfered with at its origin, but the two radial extensors of the carpus beneath it were torn away from the surfaces whence they spring. All the muscles which arise from the external condyle, with the exception of the supinator radii brevis, and anconæus, were detached from this process. The only muscle that was torn through at its origin, from the internal condyle, was the flexor carpi ulnaris. The olecranon and ulna portions of it, however, continued intact. No mischief whatever had happened to any other of the pronators

and flexors. The biceps and brachialis anticus were greatly on the stretch.

"*Blood vessels.* Though much shifting of their positions had necessarily taken place, no vessel of large size had been injured; the sacrifice, however, of smaller ones must have been great — judging from the large amount of blood with which all the soft tissues were infiltrated.

"*Nerves.* The ulna nerve was torn across where it passes behind the inner condyle. The sheath of the median was distended, and its substance permeated with blood. The other nerves were uninjured."

CASE 12. Reported by Jonathan Hutchison, in 1866. Hutchison states that the case had been observed by one of his friends, and late pupils, Mr. E. Greenaway. There is very little detail given. The following was abstracted from his report:

"Mr. Greenaway informs me that the symptoms were very definite, the forearm lengthened; the condyles of the humerus prominent below and behind the olecranon; the projection of the latter bone being quite lost. On bending the limb, the bones slipped into place almost spontaneously. The motions of the joint were quite restored after reduction, and the man did well."

The accident had occurred from a fall in a barroom in which the extremity of the elbow was struck.

CASE 13. Reported by H. D. Fulton in 1897. The following, abstracted from Fulton's article, gives all of the details contained in the report: "A man middle aged, rather muscular in build, was intoxicated at the time of the accident, and thrown from the step of the train. The entire weight of his body was sustained by one arm when the luxation occurred. There was no fracture of the olecranon. The end of the humerus formed a large prominence, posteriorly causing a marked and sufficient characteristic deformity. The radius and ulna were completely displaced upward on the anterior surface of the humerus."

CASE 14. Reported by J. E. Platt, in 1899. The case was under the care of Mr. Ray, resident surgical officer at the Manchester Royal Infirmary, to whom I am indebted for the following details: "Complete dislocation forward of upper ends of radius and ulna without fracture of the bones. The patient, a boy, age 13 or 14 years, attending the Manchester Grammar School, was attempting a 'set-off' from the parallel bars in the gymnasium, when he miscalculated his distance and fell to the floor. The palm of the left hand, with the elbow almost fully extended and with the arm behind the body, came in contact with the ground. Afterward the patient rolled over upon his left side and upon the injured limb. He was removed at once to the Infirmary, and was seen by Mr. Ray within 20 minutes of the occurrence of the accident. The elbow was flexed to a right angle and was fixed firmly in that position. The forearm appeared to be lengthened. Seen from behind, the characteristic outline of the lower end of the humerus was easily recognized, owing to the skin and triceps tendon being tightly stretched over the bone. The tendon was lodged in the groove of the trochlea. On the front of the upper part of the forearm, the head of the radius and the upper end of the ulna were made out without difficulty. Pain did not appear to be unusually marked.

"It was evident that there was a complete anterior dislocation at the elbow joint. No evidence of fracture was present, either before or after reduction. Reduction was performed without the administration of an anæsthetic. After a preliminary flexion of the elbow to free the olecranon, extension was carried out in the line of the humerus and with pressure of the knee against the upper part of the forearm.

"The radius and ulna then traced in succession and occupied the position of outward, and backward dislocation. From the last position, reduction was easily accomplished. It appears probable that the bones actually retracted the steps of backward and outward dislocation, through which they had been carried at the time and by the nature of the accident. The after-progress of the case was uneventful, and when the patient was last seen, about 3½ weeks after the occurrence of the accident, there was scarcely any impairment of the full movements of the elbow-joint."

CASE 15. Reported by Staunton in 1905. "Patient fell, striking point of elbow. It could be slightly flexed and extended and permitted a good deal of lateral movement. The head of the radius and the olecranon process of the ulna could be felt lying on the shaft of the humerus, about 2¼ inches above the condyles."

CASE 16. Reported by Isidore Cohn, 1922. Mr. P., age 50. Diagnosis: forward dislocation of both bones of forearm; fracture of both bones of forearm, middle third. Seven weeks ago, patient sustained injury for which he came under observation. Forearm was caught in a governor belt and dragged across the crank shaft. The skin of the forearm was lacerated; there was immediate loss of function in the elbow and forearm, and the patient supported his right hand in the palm of the left. Great pain followed the accident. He was attended within 20 minutes of the accident by physicians, who gave him an anæsthetic and "immobilized the fracture" in plaster for 10 to 14 days. The pain persisted, and the bandage became very tight, causing the fingers to swell. Again the arm was manipulated and a cast reapplied. Four weeks after the accident, the arm was again examined and manipulated; and cast reapplied. At the end of weeks, the third examination was made. An X-ray picture was taken and the patient told that the bones were not in good position. He was advised to have an operation done.

I first saw him December 6, 1921, at which time the following notes were made:

There was marked œdema and swelling of right arm, forearm, and hand. The elbow was flexed to a right angle, and the patient supported the forearm in the palm of the uninjured hand. The circumfer-

Fig. 1. Anterior dislocation of elbow before reduction. Case of Mr. P.

Fig. 2. Anterior dislocation of elbow before reduction. Case of Mr. P.

ence of the right arm was 32 centimeters; the left arm, 23½ centimeters; right wrist, 20 centimeters; and the left wrist 17½ centimeters.

The right elbow, when viewed from the side, is broad, and there is a marked prominence, 1 inch below the external condyle posteriorly. The anteroposterior diameter of the elbow is greatly increased. Palpation of the arm shows the swelling to be of a brawny hardness in places, and soft œdema in other places. There is no pain over either condyle of the humerus, or over the posterior aspect of the elbow. Patient was unable to flex his elbow through a greater arc than fifteen degrees. There is an angular deformity of the middle third of the forearm. The styloid of the radius is lower than that of the ulna. There is a localization of pain over the radial styloid and over the shaft of the radius on a higher level. Flexion, both palmar and dorsal, at the wrist, are greatly limited; and the fingers are stiff. The X-ray picture taken immediately, showed a complete anterior dislocation of the elbow, the olecranon lying entirely in front of the trochlea and well up on the shaft of the humerus. There was no evidence of a fracture of the olecranon. The picture of the forearm showed a fracture of both bones of the forearm with marked lateral displacement of both radius and ulna; there is also an overriding deformity, particularly of the ulna; and a small fracture of the styloid process of the ulna. The styloid of the radius is on a much lower plane than the styloid of the ulna.

The condition of the skin and the great amount of œdema present, made it advisable to delay operation for several days, during which time he was given hot baths, massage, and dry heat.

The operation was performed on December 9, and the following is a copy of the operative detail: "Operative reduction of anterior dislocation of the right elbow joint." Preoperative diagnosis: anterior dislocation of the right elbow joint with ankylosis. Unreduced fractures of radius and ulna (right forearm) at the middle third.

Postoperative diagnosis: Anterior dislocation of the right elbow joint with ankylosis. Unreduced fractures of radius and ulna (right forearm) at the middle third.

Incision was made on the outer side of the humerus, beginning about the junction of the middle and lower third, extending down the forearm about 4 inches. The radial nerve was exposed before its entry into the supinator longus muscle. The supinator was then retracted outward and the humerus approached subperiosteally between the supinator longus and the brachialis anticus. The vessels, along with the muscles and periosteum, were retracted upward. We found that the head of the radius was above the normal level and anterior to the external condyle, separated from it about three-quarters of an inch. When the capsule was opened, we found a large quantity of blood and we noted then, that there were several small fragments of bone in the olecranon fossa. The olecranon fossa was anterior to the internal condyle and rotated outward. We then saw that there was a mass of muscle tissue interposed between the olecranon and the trochlear process. An attempt was made to replace this, but this we were unable to do. Therefore, we decided to make an incision over the internal aspect of the elbow, exposing the mesial aspect of the humerus and the ulna. At this stage we noted that all the group of muscles originating from the internal condyle were interposed between the internal condyle and the olecranon. An effort was made by retraction and manipulation to get these muscles out of the fossa, but we found it impossible. After several attempts, it was decided that it was necessary to cut these muscles to obtain reduction. Then we were able, after some difficulty, to bring the condyles of the humerus in front of the olecranon fossa. The finger introduced into the olecranon fossa of the humerus, showed it to be filled up with soft tissue and rather than dislocate the lower end of the humerus out of the wound, I used a sponge, and removed what portion of soft tissue I could from the olecranon fossa. We then removed a small fragment of the tip of the olecranon, after which we were able to reduce the dislocation. Muscle sutured. It was not thought to be possible to do an arthroplasty, owing to the fact that no fascia over the triceps region was available. It was decided simply to suture the muscle planes, leaving the capsule open on the inside for drainage. The ulnar nerve was not injured. The wounds were sutured with silk worm and Michel clips. No large vessels were injured and a tourniquet was not needed.

The arm was put up in complete extension, because in that position, there would be less tendency toward a recurrence of the dislocation. Therefore, an anterior and posterior plaster splint was applied.

No effort was made to operate the fracture of

Fig. 3. Fracture of both bones of forearm associated with anterior dislocation of elbow. Case of Mr. P.

both bones of the forearm at this time, as we felt that the procedure would be needlessly long, which the patient's condition did not justify, and secondly, early mobilization of the elbow might have been dangerous to a successful result of the fractured forearm. The forearm muscles needed massage and mobilization and not immobilization.

Further, relative positions of the styloids of the radius and ulna indicated that a good functioning wrist might very well be expected if union occurred in the position as shown by the picture.

Progress notes. December 6, 1921. Patient admitted with old fracture of forearm and anterior dislocation of elbow of right arm. Carries arm flexed at elbow, forearm in splints and supported by sling. All movements limited; no pain, however, when supported as above stated. Patient ordered to have arm soaked in green soap solution each day and baked, 1 hour a day.

December 7, 1921. Usual routine orders carried out today. Patient feels better.

December 8, 1921. Patient has kept up routine orders today. Arm is much cleaner. Can flex fingers much better. There is considerable pain when arm is moved out of usual manner it is carried.

December 9, 1921, 9 a.m. Operation. Respiration after operation was as low as fourteen. 6 p.m. Respiration still fourteen. Sensation in fingers normal. Slight bloody discharge on dressing.

December 11, 1921. Temperature 99.6°. External dressing changed.

December 14, 1921. Dressing changed. Two stitch abscesses on outer side of arm. Elbow manipulated range of motion about 90° from full extension to beyond right angle. Patient seems to be in good condition. Temperature after manipulation 102°.

December 15, 1921. Arm redressed. No evidence of any infection in the wound. Range of motion of about 160° to 60° without any pain. Temperature 99°. Patient seems in good condition. Sutures and clamps removed. Passive motion.

December 17, 1921. Dressing. Large amount of synovial fluid and blood discharged when elbow is flexed.

December 19, 1921. Dressing changed. Serous discharge from joint. Wound looking well. Slight edema and redness about joint. Motion about 80 to 90°.

December 21, 1921. Wound dressed. Serous sanguinous discharge. Passive motion.

Fig. 4. Anterior dislocation of elbow after reduction Case of Mr. P.

March 15. When last seen in office January 15, 1922, he could flex elbow beyond a right angle and extend the arm to 160°. There was union of the fractures of the forearm. There was greater freedom of motion of the wrist.

FORWARD DISLOCATION OF BOTH BONES OF THE FOREARM COMPLICATED BY A FRACTURE OF THE OLECRANON

1. The first recorded case of a forward dislocation of both bones of the forearm, complicated by a fracture of the olecranon, was reported by Richet from the clinic of Phillips Boyer, St. Louis Hospital, Paris. This case has been reported in detail, in the work of Streubel and the following abstracted from that classic review, gives the interesting phases of this first case:

A robust mason, 18 years old, fell backward from a high frame, falling on his back and left hand. The patient was immediately transferred to the St. Louis hospital. The left elbow was visibly deformed with an increase in the anteroposterior diameter of the joint. The forearm was in supination and slightly flexed toward the upper arm. Any directed movement of the forearm was impossible for the patient, owing to the flail character induced by the injury. On comparing the measurements, it was found that the affected arm from the internal condyle to the styloid process of the ulna was shortened by almost an inch; from the external condyle, which was less prominent, to the styloid process of the radius, the

Fig. 5. Same case after reduction.

shortening was three-fourths of an inch. On the posterior aspect of the elbow, the olecranon, which was movable in both directions, formed a prominence 1 inch in length, though this was located in the normal position of this process. Two inches below the olecranon was a wound of about one-half inch diameter, from which a bone splinter protruded. Below this wound, the examining finger slipped into a depression below which the continuity of the bone could not be farther followed. There was also a depression on each side of the olecranon. Anteriorly, the articular fold was deformed as follows: A finger's width above the condyles one felt a round, hard, resistant swelling which seemed to lie deep in the tissue and lifted the biceps and the brachialis internus upward. When the forearm was flexed and extended, it could be felt that the swelling in the articular region was movable and during pronation and supination, it rolled toward the outside. Crepitation was plainly felt, but only such as is produced by the rubbing together of eroded cartilaginous layers. The hand was excoriated on the palmar surface, and showed traces of contusion which left no doubt that during the fall this part bore the weight of the body. From these facts Boyer diagnosed the injury as a forward dislocation of the forearm with a fracture of the olecranon. Reduction was immediately decided on. Extension and counter extension were made, the upper part of the forearm pushed back, and the arm suddenly flexed. The attempt was successful, all deformities disappeared; but, after an involuntary movement of the patient, the luxation returned. It was again reduced in the same way, and the arm put in a bent wooden splint surrounded with bandages and pillows. Three hours after reduction, the patient died with symptoms of collapse.

During autopsy, an enormous hæmorrhage was found in the lower pelvis, which had undoubtedly caused death. The brachial artery, median nerve, and median vein, had been only slightly displaced toward the inside. The biceps was contracted and described a curve, where it passed over the anterior part of the swelling, and hæmorrhage had occurred between the brachialis internus, the biceps, and supinator longus. The superficial layer of the bundle of muscles inserted in the internal condyle was intact, but the deeper part was entirely torn. This tear included the entire lateral ligament on the inside, while the external lateral ligament was almost intact. The brachialis internus was the muscle which had suffered most; its superficial part was contused, its deeper fibers entirely torn. The soft parts behind the joint showed the above-mentioned wound, which extended into the articular cavity. The triceps was inserted along the entire posterior fragment of the ulna, which for a distance of 2 inches had preserved its fastenings on the inside to the extensor capulnaris on the outside to the anconeous parvus, so that it was held in its normal place by the muscle fibers. This anatomical finding shows why the olecranon had not changed its position. The lower articular surface of the ulna showed in its posterior part a longitudinal fracture, which ran from above and forward in a posterior inferior direction, so that the anterior fragment included the body of the bone with the coronoid process; while the posterior one comprised the olecranon and an obliquely split piece of bone 1.5 inches long, which protruded downward through the wound in the soft parts. The bone of the upper arm lay behind the bones of the forearm, which had been pushed up about one-half inch beyond the condyles. The annular ligament which had remained intact, had helped to pull the radius forward. The posterior surface of the ulnar fragment was corrugated and touched the articular end of the humerus, which through friction of this fragment, had suffered a superficial loss of cartilage. The joint capsule was almost entirely torn, which accounts for the mobility of the parts, the facility of reduction and also the relapse. Streubel also mentions the pathological specimen of Dupuytren, but as you will note by the quotation, no data is given concerning where the specimen was obtained; and therefore, cannot be recorded as an authenticated case.

"The fracture had severed the ulna in such a way that the upper fragment included the inner half of the coronoid process and the entire olecranon a little below its base; while the lower fragment comprised the entire ulna with the exterior half of the coronoid process. The upper fragment had been dislocated backward and somewhat toward the inside, but the olecranon was still lying in its fossa. The lower fragment with the radius had been pushed in front and about one-half inch upward."

In the same year, 1839, Richet records the following case:

Observations in a forward dislocation of the upper extremity of the bones of the forearm, complicated by a fracture of the ulna. He cites a case of a man falling for a distance of 45 feet. The left elbow showed considerable deformity; the anteroposterior diameter was increased, the lateral diameter was practically normal, the arm was held at right angle and completely fixed. The left forearm (from internal condyle to styloid of ulna) is 1 inch shorter than right. Reduction was easily accomplished by making extension on the forearm; by counter-extension on the arm, and then suddenly flexing the forearm. The forearm was immobilized at a right angle to the arm.

There is no proof that this is not the same case as mentioned by Streubel. The only thing which suggests that there are two separate cases, is the fact that in one instance, the author stated that the reduction was easily accomplished, and in the other instance, it is recorded that the patient died within 3 hours. We would suggest that the cases are apparently one, not two.

Case 3. Reported by Morel-Lavalée in 1858. This case is unusual, because it seems to be the first recorded case of an anterior dislocation of the forearm, complicated by a fracture of the coronoid

process. The report, as abstracted from the original, follows:

On September 14, 1858, a young man of 38, was brought in with the following history:

He was lying in a buggy, when suddenly the horse became frightened. Patient tried to jump, but fell on his right side; the wheel passing over the anterior aspect of the elbow from without, inward. The following day, the elbow and forearm were so swollen that they appeared twice the size of the uninjured arm. The bony landmarks around the elbow were not evident. As the individual was quite muscular, it was impossible to make more than a tentative diagnosis, that is, a fracture of the base of the olecranon with a wound entering into the joint cavity.

The active movements of the forearm were absent, but all the passive movements, especially extension and flexion, were practically normal; all were painful. The pulse in both arms was normal, thus showing the brachial artery had escaped injury. A second lacerated wound was found over the internal condyle and a third over the external.

The following day, the swelling had increased and was associated with a high fever, the arm was red, hot, glazed, and thin. A diffuse phlegmon was found, and extensive débridement was practiced. On the 20th, two collections of pus having been found on the lower external portion of the arm, and on the superior inner aspect of the forearm, two incisions were made to evacuate the pus. The index finger was introduced into the incision over the inner aspect of the elbow and having the forearm flexed at a right angle the trochlear process could be felt; the two bones of the forearm could be felt anterior to the humerus. He then made a diagnosis of an anterior dislocation, complicated by a fracture of the olecranon. At the end of the index finger, a hard, movable mass was felt on the anterior aspect of the ulna. On a second exploration the following day, it was found that the forearm was not dislocated directly anteriorly, but anteriorly and laterally. On September 26, the patient had a severe chill, and as another occurred the following day, it was deemed advisable to sacrifice the limb before a septicæmia occurred. On September 27, the arm was amputated at the level of the insertion of the deltoid muscle.

On examining the amputated specimen, a tract filled with pus and communicating with the joint cavity was found extending upward to the lower third of the arm and downward to the upper third of the forearm. The coronoid process was fractured transversely, and was completely rotated. The muscles attached to the internal condyle were barely recognizable, having been destroyed by the external violence and suppuration. The muscles attached to the external condyle were intact; the ligaments, however, were torn. The luxation could be produced just as easily as it could be reduced.

In 1859, Richet recorded a "second case," as follows: "A man fell from the top of an omnibus. He had a dislocated hip and elbow. The first was easily reduced. The latter was complicated by a fracture of the olecranon process, which had been forcibly separated as if cut with an ax. The blow was so great that the skin was also lacerated. The finger was introduced into this wound and easily passed into the joint cavity. The luxation was complete. It was easily reduced but the dislocation recurred immediately.

"In view of such a severe injury, I wanted to know whether I should try to put the arm in a position which would be most serviceable to the individual. I reduced it and immobilized the forearm at a right angle to the arm; suppuration occurred, the arm healed with ankylosis. The patient is using the arm very well."

The next recorded case, is that of M. Rigaud reported in 1870.

Rigaud showed a case of an anterior dislocation of the elbow *with a fracture of the olecranon.* A suppurative arthritis ensued. A few days later, an amputation was performed. The articular cartilage of the humerus was ulcerated at its upper border near the external condyle and also near the trochlear process.

In 1877, Mons recorded forward dislocation of the ulna, with a lateral displacement of the radius. The case report, as abstracted from the original article follows:

On the evening of July 6, 1876, a soldier of a German Infantry Regiment, named Possuer, was admitted to the military hospital with an injury to the left elbow joint. The history was given as follows:

"During jumping exercises over a box, the man had taken a good start, but had suddenly become afraid to venture the jump, when he had arrived close to the box. Having taken such a strong running start, he was unable to check the impulse quick enough to avoid hitting the box, and struck its edge, with his elbow joint completely flexed, directly on the olecranon (Malgaigne). The pain caused by the blow and inability to use the joint caused him to ask the officer in charge, to have him sent to the hospital. Immediately on his arrival, I had him undressed, and three-fourths hour after the injury, the following condition was found:

"The left arm is slightly flexed, supported by the right, and shows a shortening of about 3 centimeters. The diameter of the elbow joint is increased in an anteroposterior direction, the soft parts surrounding it are swollen. On the radial side, an eminence is visible on a line with the external condyle. On manual examination, the posterior fossa is found completely empty; but on the flexor side, 3 centimeters above the bend of the elbow, the olecranon can be plainly felt, wedged with its tuberosity into the fossa anterior major. Over and alongside the external condyle, a bony eminence is felt, and through the tightly stretched skin, the plate-like, upper articular surface of the radius is plainly palpable. Without a doubt, we had to deal with a forward luxation of the ulna, without fracture of

the olecranon; for in that case, it would have remained in the posterior fossa, and an external luxation of the radius. The latter also is very rare and has been observed only once by Nélaton, and then only as an incomplete displacement; while in the case described, the articular surface of the capitulum radii was in a line with the fossa anterior mior.

"As chloroform was not immediately available, the swelling of the joint had increased during examination and professional assistance would have to be sent for, I tried to make immediate reduction.

"I had an orderly fix the upper arm and while vigorously extending the forearm, increasingly pronating it at the same time, I plainly saw the olecranon descending. As soon as it had slipped under the articular surface of the bone of the upper arm, I suddenly stopped the extension and now I heard a snapping sound, the entrance of the olecranon into the fossa posterior. The reduction was entirely successful, for the capitulum radii, pulled down by the extension, had also resumed its normal articular relation during pronation. The olecranon was now examined for a possible fracture during the process of slipping back into its place, but such was not found. The patient was now put to bed with the joint slightly flexed, and a moderately tight flannel bandage was applied. The arm was supported by a bran pillow and a large ice bag put over it.

"The next day, the swelling had considerably increased. There was no doubt that the ligamentum radiale cubiti posticum, capsularo, annulare and interosseum had been torn by the injury and that considerable hæmorrhage had occurred. It was only after the second day, when the discoloration had begun, that the wide extent of the extravasation became discernible. The entire arm, from the hand to the shoulder, turned green and yellow. On July 12, the swelling had already considerably decreased; the ice bag was replaced by hydrotherapeutic treatment, which was followed on July 17 by applications of liquor plumbi subacetatis. On July 25, the normal outline of the joint began to be visible, and flexion and extension were less painful. August 5, regular passive motions were commenced, which had to be interrupted again on August 15, on account of returning swelling. After applying a few leeches, this disappeared again within 3 days. On August 25, the mobility of the joint was almost normal and pain less; and on September 4, the patient could be discharged from the hospital as completely cured and fit for duty. Up to today, the end of September, he could perform his various duties without any difficulty. As I was unable to find a similar dislocation in the literature accessible to me, I thought that its publication would be of some interest. With such extensive injury to the system of ligaments, it must be considered as a very lucky coincidence that the patient could be discharged fit for duty and completely recovered."

Stimson, in 1899, reported a case in his treatise on fractures and dislocations of a forward dislocation of both bones of the forearm, associated with a fracture of the olecranon. He doesn't give the details regarding the case.

Batut, in 1910, recorded an old dislocation of the elbow complicated by supracondyloid and fracture and anterior dislocation of the head of the radius. This case, of course, does not properly belong in this series, as there is only an anterior dislocation of the head of the radius. Reports abstracted from Batut's work relative to this by Dr. Paul G. Lacroix, from the original, follow:

"After many attempts to reduce an anterior dislocation of the head of the radius complicated by a supracondyloid fracture, M. Foutan of Toulou, finally plated it and there employed massage for a period of 6 to 7 months. Six years later the case was seen by the author who found that flexion of the forearm was normal, but extension was limited to about 130 degrees. The right forearm was 3 centimeters shorter than the left. The anteroposterior diameter was increased. The ulna was normal. No trophic disturbances were noted." Even though extension was limited to 130 degrees, the author decided not to operate. He advocated active and passive exercise, massage, and contrast baths as a means of increasing the mobility of the elbow joint.

ETIOLOGY — MECHANISM OF DISLOCATION AND PATHOLOGY

In reviewing the literature, it is found that by far the greatest number of cases of uncomplicated forward dislocation of the elbow have resulted from a blow on the flexed elbow. One case occurred following the forearm being caught in a fly wheel (Caussin). One case resulted from the handle of an unwinding chain striking the patient on the under surface of the left elbow. The cases complicated by a fracture of the olecranon or coronoid resulted from a fall on the hand; a fall on the flexed elbow; or as in one case, the result of the wheel rolling over the elbow.

The majority of authorities have considered the fall on the flexed elbow as the most likely method of the production of this deformity. Colson and Huguie, after studying their case and making experiments on the cadaver, reported the following results:

"Forward dislocations without fracture of the olecranon may occur in three ways: first, by forced flexion of the forearm; second, by fixing the upper arm and turning the forearm around the axis of the forearm; third, by hyperextension of the forearm."

Though this work was done nearly one hundred years ago, there seems to be little to

add in regard to methods by which this deformity can be produced, as all of the cases which have been reported, have resulted from one of the three mentioned possibilities.

The pathology in all cases is one of extensive laceration of the ligaments about the joints, and extensive injury to the muscles; or stripping up of the muscles from their bony attachment. These points can be readily verified by referring to the individual case reports.

The results which have been obtained in the uncomplicated cases are not stated in six, and are given as "cured or almost complete usefulness," in seven. There was an amputation in one case. In the cases complicated by fracture of the olecranon or coronoid, there were three amputations, two cured and one improved. From the foregoing, it would seem that the prognosis should be good, provided the patient is seen early enough, and the injuries to the soft parts not sufficient to call for an amputation. When seen late, as in the author's case, operative reduction offers the only possible method of obtaining a useful elbow. Furthermore, where there is so extensive a stripping up of the muscle from the bones as was illustrated in the author's case, where there was an interposition of soft parts between the respective joint surfaces, there is *no possibility* of reducing the deformity except by an open operation.

CONCLUSIONS

Anterior dislocations of both bones of the forearm are rare. Only twenty-three cases, including the case herewith reported, have been found in a review of the literature. In all cases which have been verified by operation or autopsy, there has been an extensive laceration of the ligaments about the joint and a stripping up of the muscles in the immediate vicinity from the respective bones.

Anterior dislocations of the elbow may be either uncomplicated, or associated with a fracture of the olecranon or coronoid process. A review of the literature suggests that some of the cases have been reduced with very little difficulty.

The case which forms the basis of this report, showed that there was an extensive stripping up of muscles and interposition of soft parts between the lower end of the humerus and the ulna. Such a condition shows the impossibility of a non-operative reduction, particularly if seen late, as in this case.

The approach to the elbow in such instances had best be done by lateral incisions rather than the linear posterior incision, or the method recently suggested by MacAusland. The position after operation had best be one of complete extension, because the olecranon in complete extension is fixed in the olecranon fossa behind the trochlea. If the elbow is put in hyperflexion there is a tendency of the olecranon to slip forward again and reproduce deformity. After a few days it is advisable to begin mobilization of the joint.

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SUBASTRAGALOID DISLOCATION OF THE FOOT

BY BEVERIDGE H. MOORE, M.D., CHICAGO

SUBASTRAGALOID dislocation of the foot, in which the os calcis and the scaphoid bone are displaced from the astragalus, while the astragalus retains its normal relation with the tibia and fibula, is a rare injury.

Sir Astley Cooper, in his book *Fractures and Dislocations*, describes two cases which he saw and reduced in 1815. He considered the injury as a dislocation of the astragalus.

Broca, in 1853, collected the cases reported, classified them, and gave the name subastragaloid dislocation of the foot, to the injury. In considering the foot as dislocated from the astragalus, he conformed to the standard nomenclature of dislocations. In his classification he recognized three varieties, naming them, outward, inward, and backward.

Malgaigne later added a fourth variety, dislocation forward. He reversed Broca's nomenclature by considering the astragalus as the dislocated bone. This variation in the naming of the displacement has caused some confusion, but Broca's nomenclature is that generally followed now.

The German writers classify the varieties as, abduction, adduction, and sagittal subastragaloid dislocation of the foot. This has the advantage of giving a clearer mental picture of the deformity.

The latest complete reviews of the literature are by Dietz in German (1906) and by Baumgartner and Huguier in French (1907).

OCCURRENCE

It is a rare injury. Trendel states that in his clinic only one case was seen in 10 years. However, Stimson says that in a nine-year period at the Hudson Street Hospital, there were five subastragaloid dislocations, five total dislocations of the astragalus, and five dislocations of the entire foot from the tibia. During the same period there were 1089 adduction and abduction fractures of the ankle. It seems from this that subastragaloid dislocation is about as common as other dislocations of the foot, which are all of relative infrequency in comparison with fractures in this region.

As to the relative frequency of the varieties of subastragaloid dislocation, of 85 cases collected by Baumgartner and Huguier, 48 were inward, 26 outward, 7 backward, and 4 forward.

CAUSES

The history of the cases usually is that of a fall from a height in which the weight of the body is received on the abducted or adducted foot, or a violent blow, as from a falling weight, on either side of the lower part of the leg. The same causes act to produce fracture of the malleoli, dislocation of the entire foot, total dislocation of the astragalus, and fracture of the astragalus. These injuries seem to be alternative, the production of one rather than another depending on some factor which cannot be explained, entirely.

The three cases reported here were all of the outward variety. One was recent and the others of long standing.

CASE 1. W. A., male, age 50, a painter, entered Cook County Hospital August 22, 1921. A few days before he had stepped off a ladder and fallen about 9 feet, landing on his feet. He did not know the exact position of his feet when they struck the floor but he had fallen to the right after striking. The right foot had swelled immediately and he had not been able to use it at all. When seen the right foot and ankle were much swollen and ecchymosis was intense on both sides of the leg for about a third of the distance to the knee. The foot was moderately everted and abducted. Palpation was difficult on account of the swelling, but a bony projection could be made out on the inner side of the foot, below and in front of the internal malleolus. There was marked tenderness in this region and also over the external malleolus which seemed to be bent outward. Motion of the midtarsal joint and of the ankle was impossible on account of pain. He also complained of numbness of the great toe. The tentative diagnosis was, fracture of the lower end of the fibula with dislocation of the foot, outward.

The X-ray showed outward and slightly backward dislocation of the os calcis and scaphoid from the astragalus, with slight comminution of the lower portion of the anterior end of the os calcis. There was also a fracture of the fibula about 1 inch above its tip.

Closed reduction under ether anæsthesia was accomplished as follows: The knee was flexed to relax the gastrocnemius. An assistant grasped the forefoot while the operator held the heel and ankle with both hands. Traction was then made on the forefoot and an attempt made to invert it. At the same time pressure was made outward on the internal malleolus and inward on the heel. After some manipulation in this manner, the foot slipped into place with a sudden snap, and the projection on the inner side of the foot disappeared. So far as could be made out by palpation the reduction was complete. A plaster cast was applied, holding the foot inverted and at a right angle to the leg.

The following day the patient stated that the pain was all gone and that the foot "felt natural" again. The numbness of the great toe had entirely disappeared. The X-ray showed complete reduction.

The cast was left on for 6 weeks, after which adhesive strapping was used for 3 weeks longer, while weight-bearing was begun. He went to work at that time and reported at the end of another month that he was having no trouble with the foot. He was seen at that time and examination showed the ankle somewhat thickened, but with normal extension and dorsi-flexion. Lateral motion was limited moderately as was the motion at the midtarsal joint.

CASE 2. C. L., male, age 50, a hotel porter,

Fig. 1. Case 1. Lateral view before and after reduction.

entered Cook County Hospital August 29, 1921. His complaint was pain in the right foot after use, lameness and deformity of the foot. The foot was injured 15 years before. At that time he was working in a steel mill. While squatting down with the right knee completely flexed and his weight resting mainly on his right foot, a steel rail fell across the lower part of his right thigh. His right foot was twisted violently. He states that the foot was turned outward. An attempt was made to correct the deformity and a splint was applied. He was kept in bed for a month, after which he began to walk, though it was very painful. After the swelling subsided the foot was still turned outward and there was a large "lump" on the inner side of the foot just in front of the ankle. This gradually became more prominent and the foot became more flattened and turned out as he used it. With specially made shoes he had been able to continue working at odd jobs, though he limped badly and walking was very tiresome.

On examination the right foot was found much everted and abducted. It was shorter in front of the tibia than the sound foot. The internal malleolus was nearer the sole than normal. The external malleolus was displaced forward on the outer side of the foot. About an inch in front of the internal malleolus and just below its level there was a rounded bony projection, about the size of a walnut. The ankle motions were normal except the lateral motion which was much limited. Motion at the midtarsal joint was very slight. There was marked hallux valgus of both feet, more marked on the right. On weight-bearing the eversion was increased so that the projection on the inner side of the foot almost touched the floor. On walking the whole leg was voluntarily rotated outward so that the foot was almost at a right angle to the direction of progress. This produced a gait with no spring from the right foot, resulting in a marked limp.

The X-rays were difficult to interpret. The lateral view showed a flattened, longitudinal arch. The astragalus was in normal relation to the tibia, but the lower border could not be made out clearly and the whole bone appeared to have sunk down-

Fig. 2. Case 2. Foot before (left) and after (right) astragalectomy.

ward in relation to the scaphoid and os calcis. The anteroposterior view showed the head of the astragalus dislocated inward from the scaphoid and the os calcis dislocated outward from the astragalus. The fibula showed evidence of an old fracture about 2 inches above its tip. There was also considerable arthritic change in the joints of the tarsus. Operative removal of a portion of the astragalus to correct the faulty weight-bearing was advised. A small superficial abscess developed on the dorsum of the foot and operation was delayed until it had healed.

September 27, 1921. Operation. Total astragalectomy. An incision was made over the projection on the inner side of the foot. This bony projection was found to be the head of the astragalus. The tendon of the tibialis anticus muscle lay across the neck of the bone, which was in the normal relation to the tibia and fibula. The entire astragalus was removed intact. The ligaments in the region were examined but it was impossible to determine which had been ruptured by the injury.

After removal of the astragalus the eversion and abduction of the foot were easily corrected. As noted in the examination, the external malleolus was farther forward on the foot than normal, and this made backward displacement of the foot on the tibia very easy. This placed the foot in a stable weight-bearing position. The position was maintained by a kangaroo tendon suture through the internal malleolus and the scaphoid. The wound was closed in layers and a cast was applied holding the foot inverted and in slight equinus.

The astragalus was carefully examined after removal, but no evidence of old fracture was found.

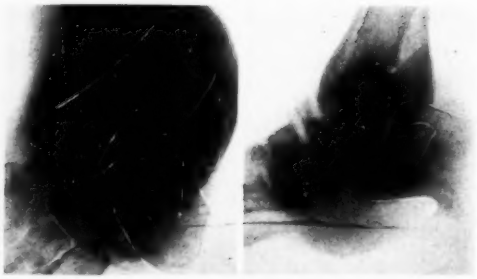

Fig. 3. Case 2. Roentgenograms of foot showing dislocation.

The cartilage covering the head of the bone had been almost completely absorbed.

The cast was removed in 7 weeks and a shoe built up on the inner side, to maintain the corrected position, was used. Weight-bearing was gradually begun.

Three months after the operation the patient was walking, with a cane usually, though he could walk short distances without it. He had no pain. The eversion and abduction of the foot were corrected so that the weight was borne in the normal line. There was about 20 degrees of motion at the ankle though the foot could not be dorsi-flexed quite to a right angle. His gait was much improved, as there was much more spring from the foot. At first he rotated the whole leg outward as had been his habit before the operation, but when his attention was called to this he corrected it voluntarily, with considerable improvement in his walking. He was then working as a hotel clerk.

Case 3. B. T. D., age 52, telephone repairman. Injury received about 30 years ago, as follows: While helping to set a telephone pole it slipped so that the greater part of the weight was thrown suddenly on the cant hook he was using. It struck his left ankle violently on the outer side so that his foot was twisted outward. An attempt was made to reduce the deformity but it was only partially successful. He was disabled for some time but gradually resumed walking and work. The deformity increased gradually for some time after he began bearing weight on the foot, but in general it caused him very little trouble. He has taken on considerable weight the past few years and states that the foot becomes quite tired and aches a good deal especially after carrying more than the usual amount of weight.

Examination shows the foot moderately everted and abducted and the sole much flattened. There is a moderate projection of the head of the astragalus on the inner side of the foot. Both the external and internal malleoli are lowered, i.e., are nearer the sole than normally. The foot just below the malleoli is much broadened. The inner surface of the heel is inclined toward the horizontal. Dorsi- and plantar flexion of the foot are both normal, but the lateral motions are much limited. Motion

at the midtarsal joint is slight. The patient walks with the foot pronated and abducted and there is a slight limp. Since the foot was functioning so satisfactorily to the patient no operative treatment was advised.

X-ray findings. The lateral view shows marked flattening of the longitudinal arch with lowering of the astragalus so that its lower border is below the upper border of the os calcis. There is considerable arthritic change of the joints of the foot.

The anteroposterior view shows the os calcis displaced outward and lying almost parallel to the astragalus. There is some separation of the joint between the scaphoid and cuneiform bones. There is some evidence of a fracture of the anterior portion of the os calcis. The anteroposterior view of the ankle shows the os calcis at almost the same level as the astragalus and to its outer side. The astragalus is in normal relation to the tibia.

Fig. 4. Case 3. Roentgenograms showing partial dislocation of head of astragalus and complete dislocation of os calcis.

In all three of these patients the same primary cause was active, that is, a violent wrenching of the foot outward by a force applied from above. In all of them the foot was probably at nearly a right angle to the leg at the moment of injury. This bears out the experimental work of Baumgartner and Huguier on the cadaver. They found that the dislocation could be produced only by pure abduction of the foot, that is, with the foot at right angles to the leg. They also found that it was necessary to cut the interosseus ligament between the os calcis and astragalus before the lesion could be produced experimentally. If this was not done, fracture of the malleoli resulted.

In the second case the position of the foot at the time of injury was known with reasonable exactness. In the squatting position the foot is at a right angle or less with the leg and is either slightly everted or inverted, depending on whether the weight is borne more on the inner or outer side of the foot. A heavy weight striking the thigh will cause a backward and downward thrust of the tibia, which will cause dorsi-flexion of the foot. In this patient it resulted in a subastragaloid dislocation of the foot outward. It is interesting to note that Stimson describes a case in which injury was produced in almost identical fashion, yet in his case it was a Pott's fracture which resulted.

In the third case the foot was also probably at very nearly a right angle at the time of injury. I have seen recently a case in which the mode of injury was very similar, that is, a blow by a heavy weight falling on the outer side of the ankle while the patient was in the lifting position, in which a fracture of the lower end of the fibula and a crushed fracture of the astragalus were the result.

It seems fair to say that there is no cause which will constantly produce subastragaloid dislocation, but that it is an alternative injury with abduction and adduction fractures in the region of the ankle joint.

The reason for the great preponderance of fractures over dislocations in this region is to be found in the structure of the joints. They are formed by such powerful ligaments that it is easier to produce fracture of the bones than the ligamentous tear necessary for dislocation. Both of the old cases reported give a history of increase of the deformity after weight-bearing was begun. When we consider that, in order to produce a subastragaloid dislocation outward, the interosseus ligament between the astragalus and os calcis, the astragalo-calcaneous ligament, and a portion of the deltoid ligament must be torn, thus depriving the posterior portion of the foot of its most important support, this seems a necessary consequence. In addition to the loss of support the weight-bearing line is shifted outward, and this increases the need for support.

In this connection the X-ray findings are of interest. In Case 1, which was recent, there is a marked dislocation of the head of the astragalus from the scaphoid and a separation of the os calcis and astragalus with comparatively little dislocation between them, In the two long-standing cases, the astragalus has

sunk markedly downward as the result of weight-bearing. The other points of interest in the X-rays are the relations of the axes of the astragalus and os calcis. In all the cases the longitudinal axes cross instead of being practically parallel as is normal. In the first and third cases this crossing is at an acute angle, about 20 degrees, while in the second it is at a much greater angle, about 50 degrees.

The two old cases also show a slight separation of the scaphoid from the cuboid and cuneiform bones, though not enough to be an actual dislocation. Quénu noted this finding in a case report in 1918. It is probably a constant finding. Most of the cases in the literature were reported before the X-ray came into use, so that minor associated injuries would easily escape notice.

Both of these cases also show marked arthritic changes especially in the joints involved in the dislocation. These changes may depend in part on injury to the periosteum at the time of the original injury.

TREATMENT

Primary reduction is most desirable and gives excellent results. The method of reduction depends on the variety of the dislocation, and utilizes the underlying principle of the reversal of the force causing the dislocation.

Irreducibility is not infrequently a complication mentioned in the case reports in the literature. The causes given are: (1) Interposition of a portion of the annular ligament between the scaphoid and the head of the astragalus. (2) Engagement of the neck of the astragalus by the tendon of the anterior tibialis muscle or in extreme cases by the tendon of the posterior tibialis. Quénu lays stress on the first cause, while Baumgartner and Huguier emphasize the second. Either condition would call for open reduction.

For old dislocations, astragalectomy is the method of choice. Quénu advocates it for all over 9 days old. This seems rather radical as the first case reported was not reduced until 2 weeks after the injury, and yet no great difficulty was encountered and the result was good. One case is reported in the literature in which closed reduction was accomplished 6 months after the injury. This was in the pre-antiseptic period and at the present time probably would have been operated on.

Baumgartner and Huguier collected the results of 23 astragalectomies for old, irreducible, and compound subastragaloid dislocations. Of these, 13 gave good function, 6 resulted in ankylosis, 1 required secondary amputation, and 2 resulted in death from sepsis. These cases included those operated on in the pre-antiseptic period. Since their report, Thienhaus and Quénu have each reported an old case treated by astragalectomy, with excellent results.

SUMMARY

Subastragaloid dislocation of the foot is a rare injury, alternative with abduction and adduction fractures in the region of the ankle.

The physical signs of subastragaloid dislocation outward are, eversion and abduction of the foot, with prominence of the head of the astragalus on the inner side of the foot. In old cases there is lowering of the malleoli and thickening of the foot below the malleoli.

Treatment in recent cases is reduction, either open or closed as may be indicated. Total astragalectomy gives good results in old cases.

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DEPARTMENT OF TECHNIQUE

FRACTURES OF BOTH BONES OF THE FOREARM WITH GREAT DISLOCATION TREATED WITH PIN TRACTION

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THE conservative treatment of fractures of bones of the forearm when the fragments are in bad position usually gives unsatisfactory results. To obtain a correct anatomical result and especially to restore function, it is of great importance in these cases more than in fractures of other bones that the fractured bones be brought into good position. Even when a good position of the fragments is obtained, the end-result may be disappointing because of excessive callus formation or because the fragments do not unite.

The closed method of reducing a fracture, even with the patient under general anæsthesia, is extraordinarily difficult and sometimes impossible. The ambulatory treatment, with extension splints, as recommended by Bardenheuer, Helferich, Heusner, Hey Groves, and others, fails in many cases, and permanent traction by means of adhesive plaster, applied with bed rest, does not always reduce the dislocation. Steinmann, Wilms, and Schmerz recommended direct traction on the broken bones to obtain reduction. But these methods do not give satisfactory results and many surgeons have decided that open reduction is the best method of treating fractures of the forearm with marked overriding of the fragments. This operation has technical difficulties and risks; and the fixation in plaster necessary to secure immobilization of the forearm promotes stiffening of the joints and hinders functional recovery. It seemed advisable, therefore, to seek a more simple method of treatment and we wish to recommend the technique described below—a distinct traction dressing with pin extension, as recommended by professor Dr. W. Noordenbos.

Two pointed steel pins are used. One, approximately 17 centimeters long and 2 millimeters thick, is introduced just above the radio-ulnar joint through the ulna and then through the larger radius; the other pin of the same diameter but shorter is inserted just below the olecranon through the ulna only. The pins are best introduced under general anæsthesia; and, if aseptic precautions be taken, there need be no danger of infection. Traction in opposite directions is exerted on each pin.

The patient is put to bed, and the forearm is held suspended vertically by means of two metal

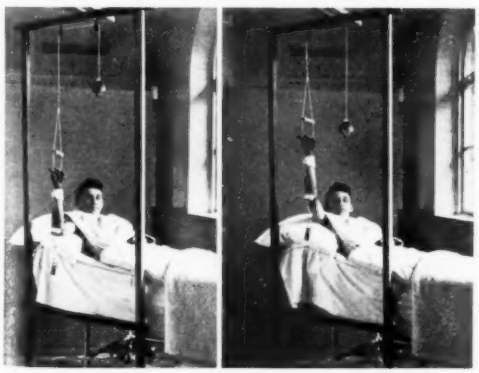


Fig. 1. Case 2. *a* and *b* show active mobilization of the joints.

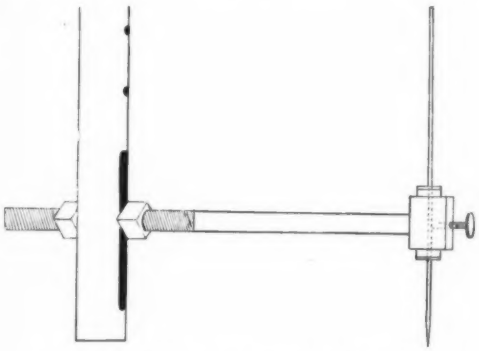


Fig. 2. Diagrammatic sketch of pin and handle frame used by author in pin-traction apparatus.

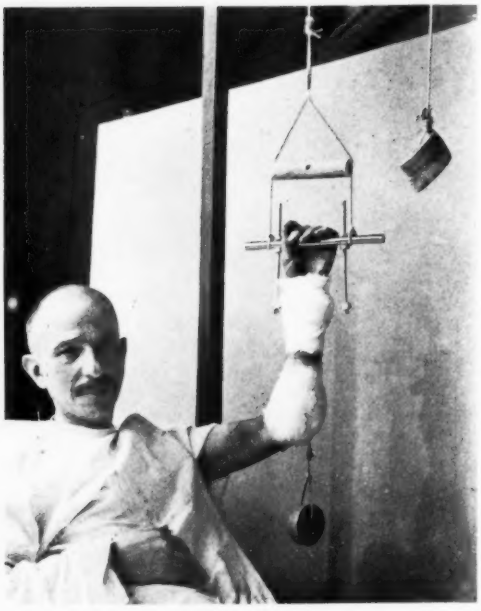


Fig. 3. Case K. v. K., showing application of apparatus.

wires attached at one end of the longer pin at wrist and at the other end to a cord on the end of which a weight is tied. The upper arm lies horizontally on the bed. The weight cord operates over two pulleys. A cylinder, or handle, is placed between the metal wires at the correct distance. A lesser weight is attached to the shortest pin. The weights vary from 2 to 5 kilograms for the longest pin, and from ½ to 3 kilograms for the shorter, depending on the degree of dislocation and the muscular force. During treatment the fluoroscope is often used to control the position of the fragments. It is very important that the patient be able to move all joints, as this prevents stiffening and muscular atrophy (Figs. 1a and b). If desired, the traction power on one of the broken bones can be amplified by shortening the proper metal wire.

An improvement has been obtained by substituting for the metal wires a simple apparatus as shown in Figure 2, by means of which connection between the pin and the handle is steadier. The pin and the handle with both side bars form a frame which is adjustable lengthwise and sidewise. By removing the screw bolts on one side, the greatest traction power can be exerted on one of the broken bones. And, moreover, the frame can be turned without difficulty, so that the degree of pronation and supination can be modified (Fig. 3).

Though there need be no danger of infection, it is desirable to remove the nails after about 3 or 4 weeks, as otherwise disturbances (by pressure on the bone tissue) may occur. It is easy to remove the nails. To prevent infection, the skin is disinfected, and the end of the pin that must pass the channel is sterilized with a spirit flame.

Eight patients have been treated with this pin-extension method. Successful healing, with prompt bony consolidation and good function, is the rule. A pseudarthrosis was not to be found. In Case 8, with a complicated fracture, consolidation of the ulna was delayed.

When the broken bones are not yet consolidated and the extension apparatus is removed, the treatment must be continued by means of a short plaster splint and massage.

The table shows the length of time consumed in treatment and the end-results.

CASE 1. K. K., a fireman, age 29, fell December 25, 1919, a distance of 3 meters, and broke the right upper arm in the middle and the forearm three fingers above the wrist. As the fragments of the forearm bones were in bad position, a traction dressing with two pins was applied January 3, 1920. One pin was placed in position across the ulna and the radius. As the upper arm of the same side was also broken, the second nail was inserted through the humerus just above the condyles. The upper arm was drawn in a

LENGTH OF TIME FOR TREATMENT AND END-RESULTS

Name	Sex	Age	Length of stay in hospital	Duration of the nail-extension	Duration of after-treatment with plaster-splint	Time till consolidation	End-Results: Time		Anatomical contour				Function of forearm			
							Years	Months	Normal	Excellent	Fair	Bad	Normal	Excellent	Fair	Bad
1. K. K.	Male	29	37D	21		28	2	1			+				+	
2. W. de H	Male	18	26	19		21	1	8	+				+		+	
3. T. B.	Male	8	60	22	32	54	1	7			+				+	
4. K. v. K.	Male	50	44	30	14	44	1	7		+					+	
5. G. de L.	Male	36	43	25		30		11	+				+			
6. A. H.	Male	11	40	21		29		4		+			+			
7. H. B.	Female	36	49	25	17	42		3		+			+			
8. S. de J.	Female	19	60	35	72	108		3½		+						+

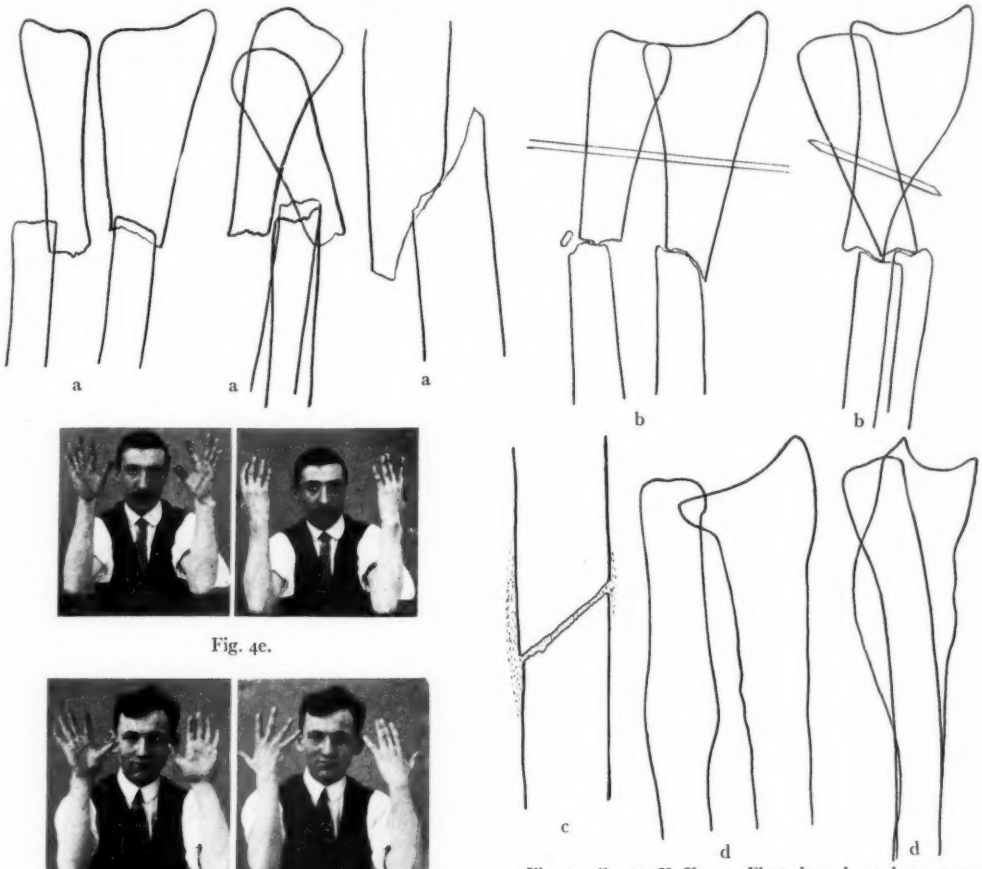


Fig. 4. Case 1, K. K. *a*, First day; *b*, 12 days; *c*, 32 days; *d* and *e*, 2 years and 1 month after operation.

Fig. 4e.

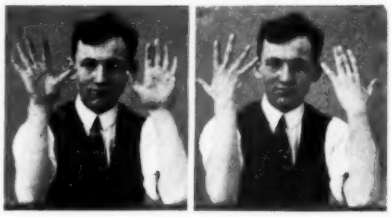


Fig. 5 f

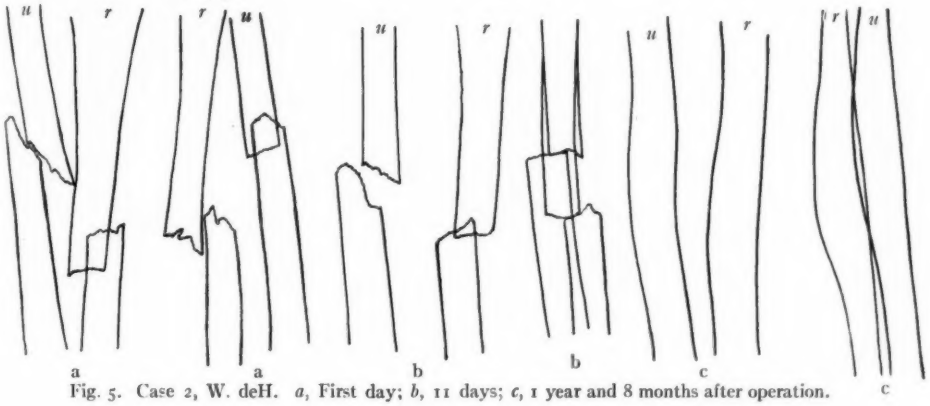


Fig. 5. Case 2, W. deH. *a*, First day; *b*, 11 days; *c*, 1 year and 8 months after operation.

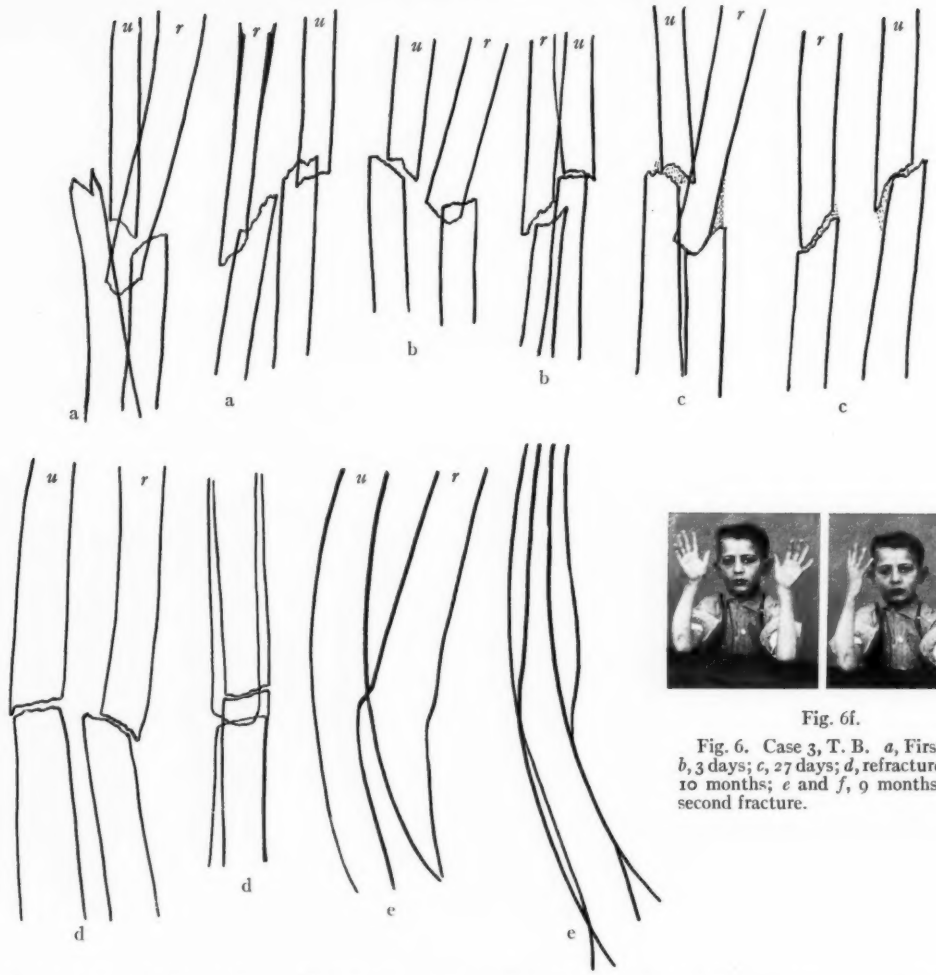


Fig. 6f.

Fig. 6. Case 3, T. B. *a*, First day; *b*, 3 days; *c*, 27 days; *d*, refracture after 10 months; *e* and *f*, 9 months after second fracture.

horizontal line, the forearm in a vertical direction. When the dressing was removed January 23, all fragments were firmly grown together in a rather good position. Although the lower part of the ulna was dislocated, and the dislocation could not be reduced, the patient soon resumed his work. It is still difficult to turn the right forearm. (Fig. 4a, b, c, d, e.)

CASE 2. W. deH., a merchant's clerk, age 18, while playing football broke his right forearm, February 19, 1920. The fragments were in bad position, and as closed reduction with the patient under general anæsthesia failed, the pin-traction dressing was applied. Soon a better position was obtained, and when the dressing was removed, March 11, bony consolidation was present. After some months, the patient could make all movements with the right arm. (Fig. 5a, b, c, d.)

CASE 3. T. B., a boy, age 8, broke the right forearm March 3, 1920. The position of the fragments was very bad, and the pin-extension apparatus was applied immediately. After 3 days the position was much better. As consolidation had not yet taken place when the dressing was removed, March 25, treatment for 3 weeks was continued with a short plaster splint. In June the functional result was perfect. Unfortunately, January 29, 1921, he broke the right forearm for the second time and at about the same level. Although the dislocation was slight (greenstick fracture) the result of the treatment with the plaster splint was much less satisfactory. At present the forearm is crooked and the supination much impeded. (Fig. 6a, b, c, d, e, f.)

CASE 4. K.v. K., a shopmate, age 50, was run over by an automobile March 10, 1920, and the left forearm broken. The pin-traction method was used and on March 25, the position of the fragments was much improved. It was found, however, that the longest pin perforated the radio-ulnar joint. The dressing was removed April 10, and 2

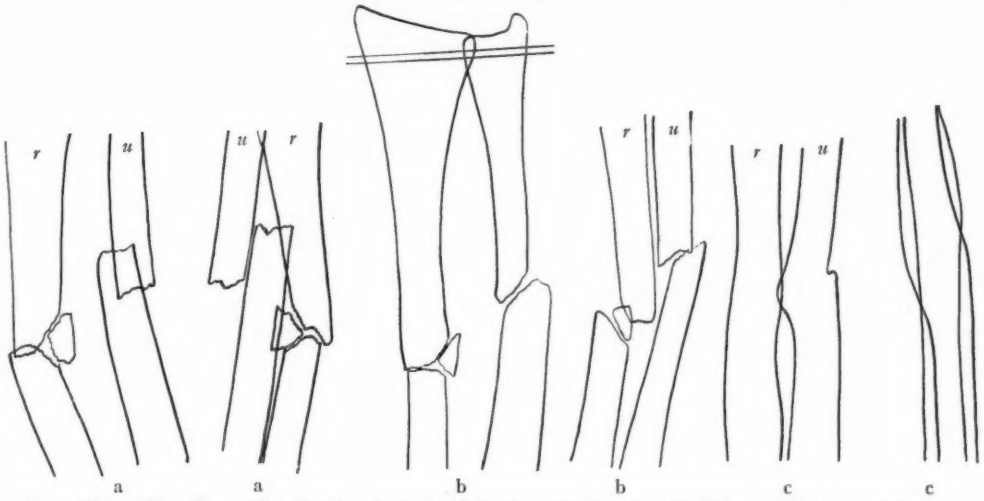


Fig. 7. Case 4, K. v. K. *a*, First day; *b*, 5 days; the pin perforating the radio-ulnar joint; *c* and *d*, 1 year 7 months.

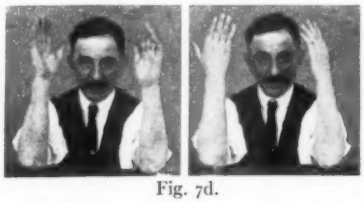


Fig. 7d.

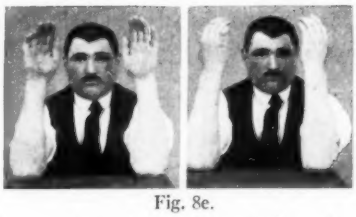
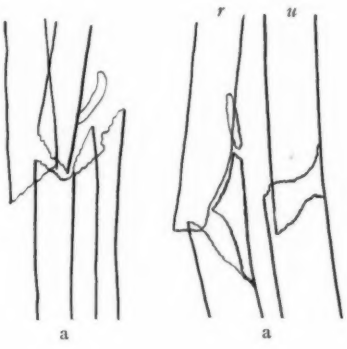


Fig. 8e.



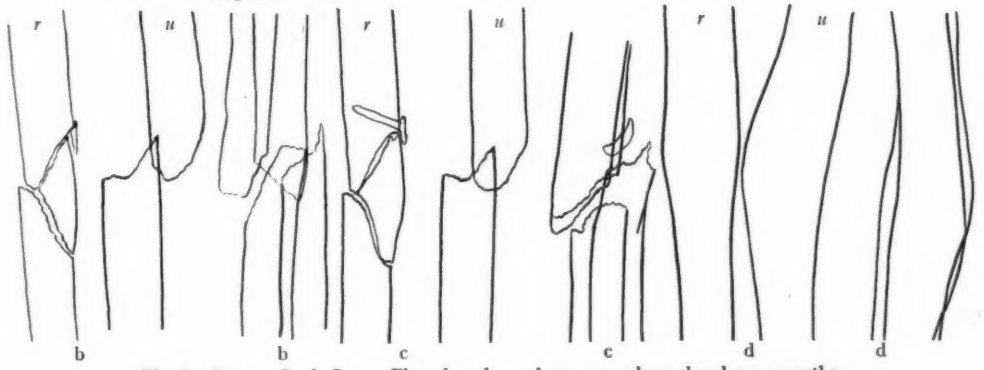


Fig. 8. Case 5, G. de L. *a*, First day; *b*, 10 days; *c*, 14 days; *d* and *e*, 11 months.

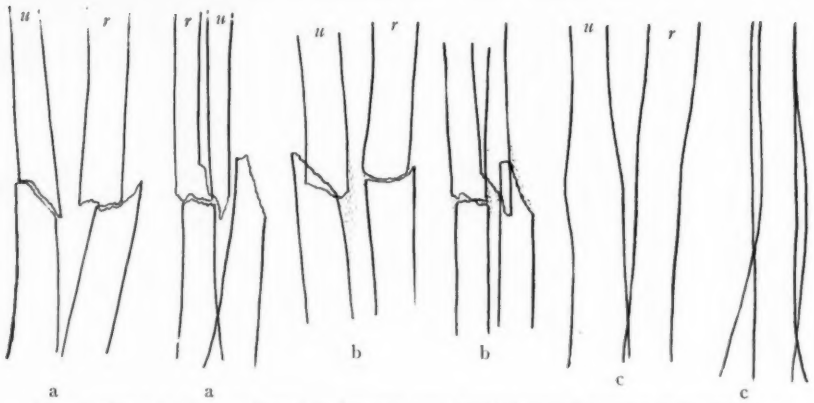


Fig. 9. Case 6, A. H. *a*, 9 days after fracture, one day after second attempt at reduction; *b*, 34 days after fracture; *c* and *d*, 4 months after fracture.

Fig. 9d.

Fig. 10d.

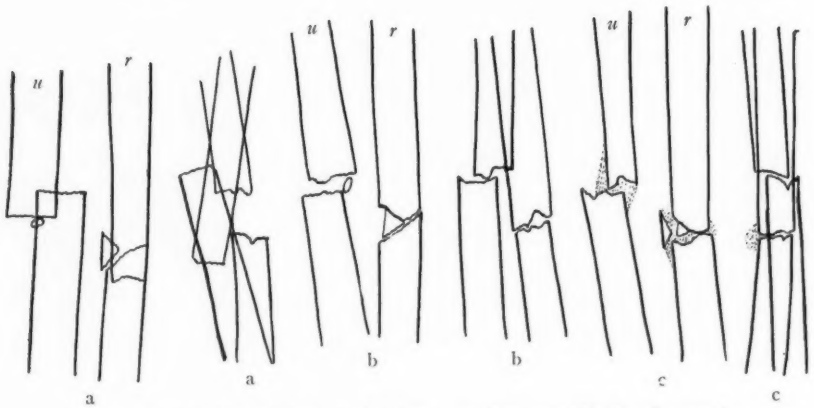


Fig. 10. Case 7, H. B. *a*, First day; *b*, 8 days; *c*, 40 days, consolidation; *d*, 3 months.

weeks afterward the fragments were grown together. Notwithstanding the good position, turning of the left forearm is still always impeded, due largely to perforating of the radio-ulnar joint. (Fig. 7a, b, c, d.)

CASE 5. G. deL., a vigorous workman, age 36, came to the hospital, February 21, 1921, suffering with a broken left forearm received in a fight. Two efforts at closed reduction, one under general anæsthesia, failed and February 26 the pin-extension apparatus was applied. The position of the radius was soon corrected and after the greatest traction power was applied for some days to the ulna by removing the screw bolts on this side, the fragments of the ulna also had a satisfactory position. When the apparatus was removed on March 22, the fragments were consolidated and the patient soon resumed his work, with a very good functioning forearm. (Fig. 8 a, b, c, d, e.)

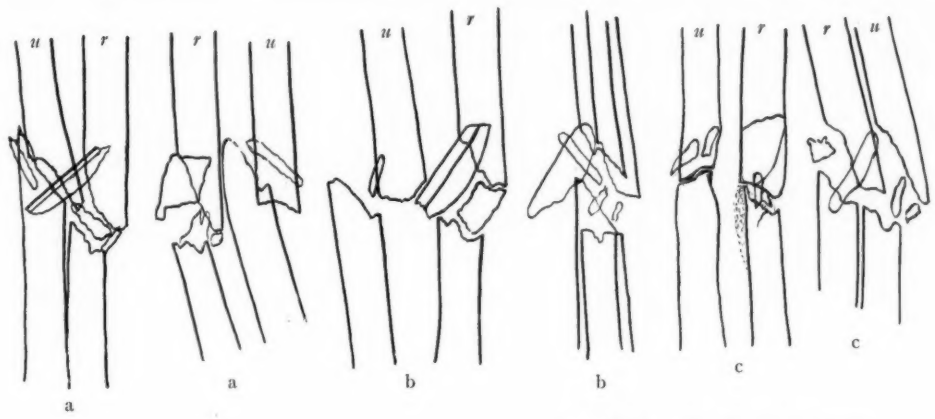


Fig. 11. Case 8, S. de J. *a*, First day; *b*, 14 days; *c*, 48 days; *d*, 3½ months.

Fig. 11d.

Case 6. A. H., a boy, age 11, broke his right forearm, September 16, 1921. Two efforts to reduce the fracture were without success, and September 23 the pin-traction dressing was applied. Soon the position of the fragments was improved, and on removing the apparatus on October 14, consolidation was attained. It lasted a short time, until the turning of the broken forearm could be performed without difficulty. (Fig. 9a, b, c, d.)

Case 7. H. B., a seamstress, age 36, fell from a bicycle and broke the right forearm October 20, 1921. Pin-traction dressing was applied, and soon the fragments were in a better position. The apparatus was removed, November 15, and 2 weeks afterward there was firm consolidation, soon followed by a perfect mobility of the right forearm. (Fig. 10a, b, c, d.)

Case 8. S. deJ., a housemaid, age 19, fell down stairs November 1, 1921, and sustained a complicated comminuted fracture of the right forearm. Fragments of the ulna could be seen in the deep mutilated wound, and the ulnar nerve was severely injured. The pin-extension apparatus was applied the next day. For several weeks pus drained from the wound which was dressed daily, but the patient did not seem to be affected by the infection. As only the radius was consolidated when the apparatus was removed December 7, it was necessary to continue treatment by means of a short plaster splint and massage. Notwithstanding the great possibility for pseudarthrosis of the ulna, on February 16, firm consolidation was attained. It is possible to turn the right forearm several degrees, but the paralysis of the ulnar nerve has not yet remarkably improved. (Fig. 11a, b, c, d, e.)

CONCLUSIONS

1. In complicated fractures of the forearm, the pin-extension method is to be preferred above other methods of treatment, because dressing of the wound is not impeded.

2. In fractures of the forearm, with overriding of the fragments, this method of treatment deserves commendation, as the results obtained are good; in using this method, an operative reduction can be avoided.

NEW TRACTION AND SUSPENSION BONE TONGS

By EMIL J. HOGLUND, M.D., Chicago

IN non-operable fractures, various types of traction tongs have been used successfully in bringing the fractured bones in good position. However, these instruments have not always brought about the desired result; in fact they have sometimes been the means of producing great deformity and shortening. Lack of success has been due, in my opinion, to the fact that incorrect mechanical principles have been followed in making the tongs. I believe that double tongs such as illustrated will overcome many of the difficulties and prevent failures.

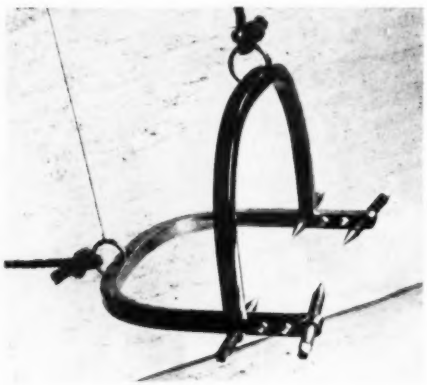


Fig. 1.

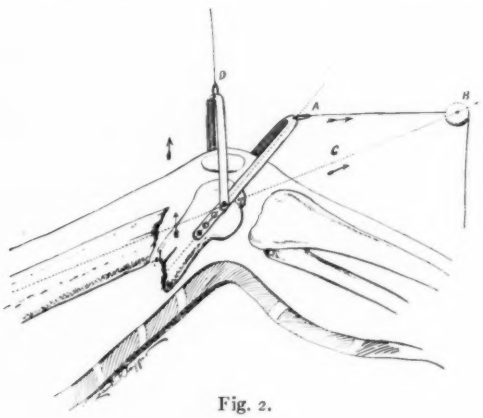


Fig. 2.

As an example of the application of the tongs, let us consider a comminuted fracture at the lower end of the femur. In such cases we always find more or less contraction of the muscles attached to the lower fragment, producing overlapping of the loose fragments. A straight pull (extension) on the lower fragment usually will bring the lower fragment down but it does not always bring the fragment in alignment with the other fragment. The desired alignment can be secured more easily and positively by means of the suspension and traction tongs; with the four screws it is possible to secure the proper amount of leverage.

Fig. 3

Figure 1 is a photograph of the tongs and Figure 2 a schematic drawing showing their application in a case of fracture of the femur. The traction tongs with rope to pulley on rod *b* should be set so as to produce sufficient leverage to bring the bones in line, *c*. The suspension tongs with rope *d* are placed in a perpendicular position to act as a pivot. The limb is usually placed in a double incline splint. The screws as shown in Figure 3 are one-half the diameter of the traction screws and are so constructed that they can be pushed through the soft tissues, enabling the operator to feel for the shaft of the bone. When the bone is located the thumb screw is screwed up into the frame of the tongs and the long screws tightened. The modification of the second screws as shown in Figure 3 is not clearly shown in Figure 1.

TRANSSACRAL NERVE BLOCK ANÆSTHESIA IN SURGERY OF THE PELVIC FLOOR AND VISCERA

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AND
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THE merit of having first called attention to the possibility of block anæsthesia of the sacral nerves belongs to Cathelin. He experimented on dogs, injecting 3 cubic centimeters of a 1 per cent solution of cocaine into the sacral canal, and obtained anæsthesia of the whole body. His attempts to produce anæsthesia in man by this method, however, failed, probably because the drug is so highly toxic that a sufficient quantity could not be injected. The direct result of Cathelin's publication in 1903 was the introduction into France of the epidural method of medicating the nerves of the sacral canal in certain chronic conditions, such as sciatica, neuralgia, lumbago, tabes dorsalis, sexual neuroses, and enuresis.

Stoeckel was the first to employ the newer and less toxic preparations, eucaine and novocaine, in injections into the sacral canal. He gave epidural injections in a series of cases of labor, and published the results in 1909. He injected 30 cubic centimeters of a 0.5 per cent novocaine solution and succeeded in substantially reducing the severity of the pains, but he could not thus establish an operative anæsthesia for any particular area. He called the method sacral anæsthesia.

It was not until 1910 that Laewen succeeded in developing a method practicable for surgical operations which attracted any serious attention. He applied the principle established by Gros, that the efficiency of the novocaine solution could be markedly increased by the addition of bicarbonate of soda, and used larger quantities of more concentrated solutions than those employed by Stoeckel. With the aid of such anæsthesia Laewen was able to perform painlessly the more common operations on the anus, perineum, and female genitalia. He called the method extradural anæsthesia.

Later, Schlimpert and Schneider injected still larger doses of novocaine and attempted to obtain sufficient anæsthesia at higher levels in order to perform lower abdominal operations. This was successful only with the aid of larger quantities of the preliminary narcotic drugs sufficient to produce semisomnolence. In this method of high extradural anæsthesia the actual extent of the block anæsthesia is largely a matter of conjecture, because of the deep preliminary narcosis before operative anæsthesia is produced. It is generally recognized that extensive operations may occasionally be performed under heavy doses of morphine and scopolamine alone, so that in high extradural anæsthesia, the block anæsthesia is often only partial and sometimes entirely superfluous. Moreover, the concomitant symptoms of high extradural anæsthesia are often quite severe, consisting of giddiness, nausea, vomiting, and even collapse. Epileptiform seizures, following high sacral anæsthesia, have been reported in twelve cases by four surgeons. Wiedkopf's collected list of fourteen fatalities for which local anæsthesia may have been responsible, included nine cases of high sacral anæsthesia. The extreme vascularity of the epidural space provides a huge surface for absorption and the high pressure occasionally necessary to force the solution into the sacral canal certainly must increase the rate of absorption. In many toxic cases reported it is mentioned that blood dripped from the needle, indicating its probable insertion into a blood vessel. While high sacral anæsthesia is still occasionally employed in abdominal operations, the present tendency, following the leadership of such authorities as Denk, Laewen, Bleek, Pauchet, and Zweifel is to use extradural anæsthesia to block off the sacral nerves only.

Low sacral anæsthesia has been rather extensively employed, and, in the opinion of those who have developed it, only needs to be better known in order to be more widely and usefully practiced. Other formulæ besides the novocaine-bicarbonate solution of Laewen and Gros have been introduced, and another term, caudal anæsthesia, proposed for the procedure. Thus, four terms, epidural, sacral, extradural, and caudal anæsthesia apply to the same procedure. In the preparation of the solution, Strauss adds sodium sulphate which he claims prevents the decomposition of epinephrin. Harris maintains that the efficiency of the solution is increased by the addition of calcium chloride; potassium sulphate has been employed

Fig. 1. Position of patient and operator for the induction of parasacral or presacral anæsthesia. (Modified from Pauchet.)

for this purpose, and Allen uses a 5 per cent solution of gelatin to delay absorption from the site of injection. Hertzler recommends the use of larger amounts of weaker solutions, and Maxeiner uses up to 4 ounces of 0.5 per cent solution in anæsthesia of the bladder. Clinical experience indicates more favorable results with larger amounts of weaker solutions and a somewhat longer period for the onset of anæsthesia.

In spite of the increasing popularity of the method, and of many attempts to improve it, a serious disadvantage persists, namely, failure in a fairly high percentage of cases. The proportion of failures varies markedly in the hands of different operators. The highest incidence of failures, 45 per cent, is recorded by Babcock. The best results are those of Pickens, who, in a series of 100 cases, admits seventeen failures. Fischer reports twenty-one failures in 155 cases of high sacral anæsthesia, but very deep preliminary narcosis was used. Any method of anæsthesia which has 15 per cent of failures after a waiting period of 20 to 30 minutes cannot become universally popular, but if some means can be devised which will bring about a practically certain operative anæsthesia, the method will meet with more general employment. Its chief use at present, outside of minor surgery of the terminal rectum and perineum, is probably in urologic manipulations (16, 41) and in obstetrics (12).

Even when anæsthesia appears, the height is variable, extending from the anal margin in light anæsthesia to complete motor paralysis of the legs in others. The region anæsthetized is, therefore, not constant for all cases and often a far greater area is anæsthetized than is required for the operative work.

Besides the variable height of anæsthesia, another drawback is the appearance of toxic symptoms. These are not, as a rule, severe, provided the injection is properly carried out and the solutions used are not too concentrated. These symptoms, which are transient and of no consequence, consist of acceleration of the pulse, palpitation, sweating, dizziness, and sometimes nausea. Vomiting and sometimes even collapse may occur. Hirschel has observed slight collapse in several cases and severe collapse in one. Scholl reports two cases of collapse of short intervals and one of transient psychosis during the correct injection of doses of novocaine as recommended by Laewen.

For operations on the female genitalia and for confinements Ilmer has recommended that the pudic nerve be blocked on both sides on the medial surface of the inferior rami of the os ischii. This procedure in the hands of Braun, Pauchet, Labat, and others has given poor results. The method seems not to be based on practical experience, as no extensive operative anæsthesia results, even though both pudic nerves are properly blocked. Anatomical relations make blocking of this nerve a difficult procedure, because on the inner surface of the pelvis it is covered by obturator fascia, and it divides before its entrance into the ischiorectal fossa. For the latter reason Franke and Posner attempted to block this nerve on the outer surface of the spine the ischium. With a finger in the rectum the needle is advanced to the ischial spine. The direction is then changed backward to the outer surface of the bone. Blocking the pudic nerve by this method was never widely attempted because of the technical difficulty and uncertainty of results. Even when blocking is successful, only scant operative anæsthesia is produced unless the coccygeal plexus, superficial perineal rami, and posterior cutaneous femoral nerves are also blocked.

A more dependable anæsthesia by a simpler method may be obtained by blocking the sacral nerves at their points of emergence from the anterior sacral foramina. This method is accredited to Braun. He calls the method parasacral anæsthesia, following Sellheim and Laewen's term for paravertebral anæsthesia, in which the nerves are injected as they leave the spinal canal. With the patient in the lithotomy position (Fig. 1), two points of injection 1.5 to 2 centimeters from the median line at the level of the sacrococcygeal articulation are selected, and dermal wheals

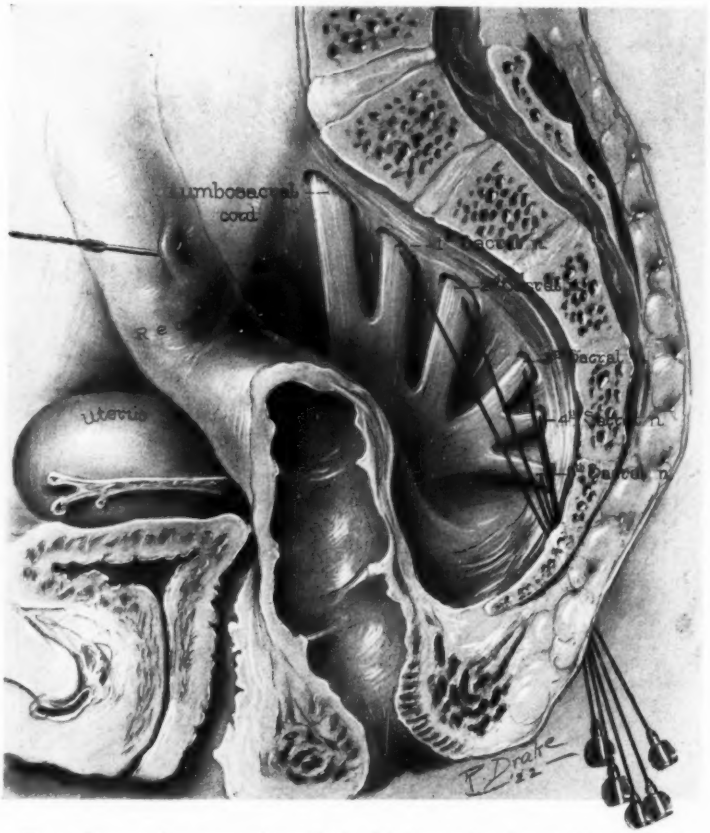

Fig. 2. Parasacral or presacral anæsthesia. Median section shows pelvic viscera displaced far forward. Normally the rectum, even when empty, rests against the sacrum.

raised. A longer needle is then introduced and the way is felt past the edge of the sacrum and along the anterior surface of the bone parallel to the median line to the height of the second sacral foramen (Fig. 2). This entire distance is injected with 20 cubic centimeters of 1 per cent novocaine solution. The needle is then drawn back to the edge and is directed at a small angle more anteriorly toward the line of the innominate bone, still parallel to the median plane. The needle is then advanced much deeper than before until it strikes the promontory of the sacrum close to the first sacral foramen where 20 cubic centimeters of solution is injected. The procedure is repeated on the opposite side, after which a final injection of 5 cubic centimeters is made between the coccyx and rectum, 100 cubic centimeters in all being used. More recently 0.5 per cent solu-

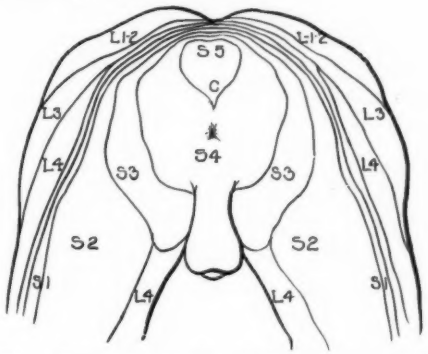

Fig. 3. Sensory innervation of the perineum showing needlessness of infiltrating the perineum for overlapping cutaneous fibers when all sacral nerves are properly blocked. (After Cunningham.)

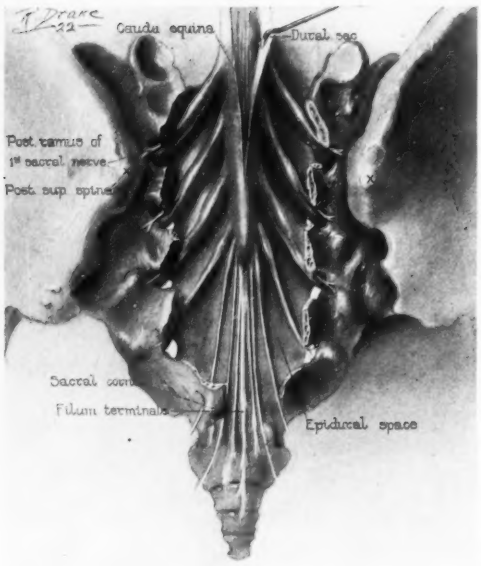

Fig. 4. Sacral portion of spinal meninges and sacral nerves in the epidural cavity, after removal of the fat, connective tissue and venous plexus normally filling this space. The sacral laminæ have been entirely removed. Note the comparative sizes of the sacral nerves and the greater proximity of the fifth sacral nerve to the median line. (After Spalteholz.)

tion has given better results, 100 cubic centimeters usually being injected on each side. Braun makes the injections without the aid of a guiding finger in the rectum, but other operators usually determine the position of the needle in this manner.

Braun has found parasacral anæsthesia more reliable than the sacral method. Its use has by no means been as widely adopted, partly because of the greater difficulty in the performance of parasacral nerve block and the consequently undependable results. In the hands of Farr, this method gives incomplete anæsthesia in about 10 per cent of cases.

While anæsthesia would be certain with accurate perineural injections for each sacral nerve trunk, such a high degree of anatomical accuracy is rarely attained, unless paræsthesia is provoked from contact of the needle point with each nerve trunk before injection. Multiple paræsthesias are very disturbing to the patient, and for this reason should be avoided so far as possible. The secret of success seems to lie in keeping the needle parallel to the median plane anteroposteriorly and maintaining constant contact with the sacral concavity.

Probably the best results obtained in any series of cases operated on under parasacral anæsthesia are those of Tolken. This series of cases is especially interesting because the preliminary narcosis was light, never being sufficient to smooth over an otherwise imperfect nerve block anæsthesia. In none of his forty-three cases was a general anæsthetic necessary, although in two instances there was considerable pain at operation. He usually infiltrated the tissues locally at the line of incision and so there may have been other cases in which anæsthesia from the parasacral injections alone was incomplete. Haertel recommends superficial infiltration of the tissues of the outer margin of the perineum in order to anæsthetize overlapping cutaneous fibers. In our experience, however, if all sacral nerves are properly blocked, cutaneous anæsthesia extends as far as the upper medial surface of the thighs (Fig. 3). In vaginal operations Haertel also combines the parasacral method with deep and superficial fanwise injections posterior to the vulva; the latter method in the hands of Hertzler was alone sufficient for perineorrhaphy. Franz combines spinal anæsthesia and the parasacral method in resection of the carcinomatous rectum, when the duration of the spinal anæsthesia is not sufficient for the conclusion of the operation.

The passage of needles through the perineum according to the parasacral or presacral method is not without an element of local danger. The rectum, even when entirely empty, fills the concavity of the sacrum, and when bound down or partially fixed by pelvic adhesions, or displaced by pressure from neighboring structures, the risk of perforation cannot be denied. Infection may also be spread by the needle punctures when a septic area is traversed. Similarly, the possible dissemination of cancer cells from secondarily involved perirectal lymph glands in cancer of the rectum must be kept in mind.

In 1913, Danis proposed a method of blocking the sacral nerves through the posterior sacral foramina and named the technique transsacral anæsthesia. In the opinion of many operators, Danis' method has overcome many of the inconveniences and disadvantages of parasacral and sacral anæsthesia. However, it was never adopted by the Germans, nor is any mention of the method made by Braun or Haertel. In the hands of Pauchet and his associates, this method has gained much favor, and Olivieri of Buenos Aires regards it as the method of choice in surgery of the perineum. In the Mayo Clinic transsacral

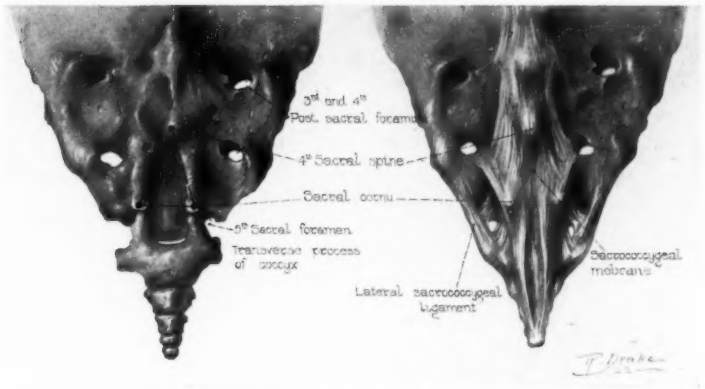

Fig. 5. Bony landmarks of the sacral hiatus. Figure to the left (+) marks the site of puncture for entrance into the canal. To the right the hiatus is covered with the sacrococcygeal or obturator membrane.

nerve block has given such satisfactory results that a detailed description of the technique with a report of 225 conservative operations by this method seems to be merited.

ANATOMICAL CONSIDERATIONS

In the present consideration of transsacral nerve block, the most important anatomical features of the sacrum are the canal and its contents and the topography of its posterior aspect. The sacral canal is a continuation of the spinal canal and is enclosed by the bony walls of the sacrum, except at its lower end where it terminates in the hiatus sacralis. The canal is triangular above and relatively large, growing smaller and flattened below. It follows the forward curvature of the sacrum which is variable in different persons and in the sexes. It contains the dural sac, which usually ends at the lower border of the second sacral segment. Within the dural sac the nerves of the cauda equina are bathed in spinal fluid (Fig. 4). As each pair of nerve roots of the cauda equina passes outward, the nerves lie free for a variable distance in a tubular extension of the dura before the latter blends with and contributes to the thickness of their sheaths. As the nerve trunk reaches the sacral foramen, the contribution of the dura to the perineural sheath is no longer evident.

In the sacrum the dura is not attached to the periosteum, as in some other localities, except by the downward continuation, the filum terminale, at the lower end of the sacrum. The space between the dura and the periosteal lining of the canal is called the epidural cavity and is filled with delicate fat, areolar connective tissue, lymphatics, and venous plexus.

The lower end of the sacrum presents a triangular opening on its posterior aspect, the hiatus sacralis, giving entrance to the sacral canal (Fig. 5). The extremities of the base of this triangle are marked by the two sacral cornua, which represent an undeveloped fifth spinous process. The apex of the triangle is designated by the termination of the crista sacralis, the fourth sacral spine. The hiatus is covered over by the posterior sacrococcygeal ligament or obturator membrane. The size of the sacral hiatus varies greatly, according to the degree of closure of the posterior arches of the sacral segments and amount of ossification of the obturator membrane.

The four posterior sacral foramina lie between sacral segments and give passage to the upper four pairs of sacral nerves. The fifth sacral nerve passes through the sacral hiatus, runs laterally below the sacral cornu, and lies in the sacral notch below the fifth segment. This bony notch with the aid of the lateral sacrococcygeal ligament forms a fifth foramen. These foramina lie in the same straight lines on either side of the crista sacralis, are oval or circular in shape, and covered over by ligamentous structures. They traverse the sacrum anteroposteriorly and almost perpendicularly to the tangent of the sacrum (Fig. 11); they are very nearly equidistant from each other, the distance between foramina decreasing somewhat from above downward. A line connecting the most prominent points of the posterior superior iliac spines lies between the first and second foramina, but nearer the second.

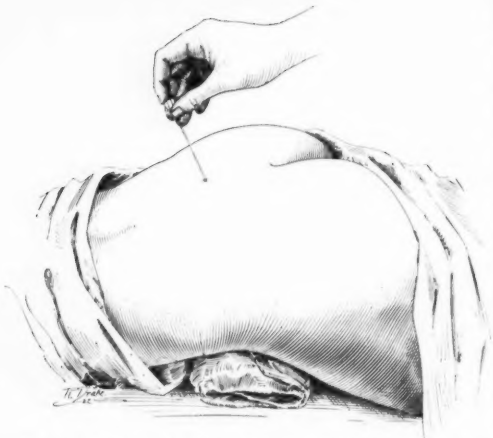

Fig. 6. Position of patient and operator for induction of transsacral anæsthesia. Note the method of holding the needle and inclination in searching for foramina at that level.

TECHNIQUE

The patient is placed in the ventral decubitus position with a cushion under his hips (Fig. 6). This elevates the buttocks, partially flexes the hips and serves to accentuate the bony landmarks. The horizontal position also promotes a more favorable diffusion of the fluid, for if gravity exerts an influence in causing fluid to escape through the anterior sacral foramina, it will continue to bathe the sacral nerves on the anterior aspect of the bone.

The cutaneous area around the sacrum and over the buttocks is sterilized in the same manner as for a laparotomy. It is first cleaned with benzene, and then painted with tincture of iodine which is removed with alcohol.

With the index finger of the left hand the tip of the coccyx is palpated in the anal groove. The finger then follows the posterior surface of the coccyx upward until the two sacral cornua are felt on either side. The cornua are the most prominent lateral tubercles encountered and are almost always definitely palpable. Location of the sacrococcygeal joint, by movement of the coccyx with a finger in the rectum (36), is useless and troublesome when such reliable landmarks as the sacral cornua are available. Somewhat higher in the median line the finger identifies the fourth sacral spine, indicating the apex of the triangle guarding the entrance to the canal. The obturator membrane forms a depression within these three points, and often gives the examining finger a sensation which has been compared to that produced by palpating a fontanelle. With the finest hypodermic needle a dermal wheal is raised in the center of the sacral hiatus and the underlying subcutaneous tissues and the obturator membrane are infiltrated so that the passage of the larger needle will not cause pain. A spinal puncture needle of small caliber is then introduced through the skin with the bevel upward and at an angle of about 20 to 30 degrees with the skin surface (Fig. 7). There is a sensation of increased resistance as the sacrococcygeal ligament is reached, and when this is perforated the point of the needle impinges against the bone of the anterior wall. Whenever the needle is felt to pierce a dense membrane, pass through a free space, then come in contact with bone, there is no doubt but that the sacral canal has been entered. The needle is then withdrawn 1 or 2 millimeters and depressed about 20 degrees farther until approximately parallel to the sacral canal. It is then advanced gently and slowly about 3 or 4 centimeters into the canal, and usually passes readily. If bony resistance is encountered, the needle should be rotated, depressed at its base, and either raised or lowered at the shoulder, being thus gently manipulated until the bony resistance is passed. The stylet is then withdrawn leaving the needle in place. If blood or spinal fluid escapes it has entered one of the large veins or the dural sac, and it should be slightly withdrawn or its position changed until the blood or spinal fluid ceases to appear. The syringe is then connected and the injection made very slowly and gently. The needle is withdrawn as the injection progresses until 20 to 30 cubic centimeters of the novocaine solution has been injected, when the tip of the needle is just inside the obturator membrane.

The crest of the ilium is then palpated and followed posteriorly until the posterior superior spine is located (Fig. 8). The most prominent point of this spine is then determined and a dermal wheal made about 1.5 to 2 centimeters inward and about 1 centimeter downward (25). This point should lie above the second sacral foramen. Another wheal is made just below and lateral to the sacral cornu which locates the fifth foramen. The distance between these foramina is then divided into three equal parts by two more dermal wheals, which mark the position of the third and fourth foramina. Another wheal is then placed in line with these four and above the first, usually about 2 to 2.5 centimeters, for the location of the first sacral foramen.

The thickness of the soft tissues overlying the sacrum is much greater above and decreases downward, which necessitates the employment of

needles of different length in searching for the various foramina (Fig. 9). Less discomfort is given the patient when the smallest needle possible is employed in probing for a given foramen.

With an 8-centimeter needle the anæsthetized skin is perforated over the second foramen. The needle is then inclined somewhat downward until it is thought to be perpendicular to the tangent of the sacrum at that point, and slightly inward. It is then gently advanced until it either comes in contact with bone or passes through the foramen. If it comes in contact with the bone, it is gently withdrawn and another search for the foramen is made. In this way, the distance from the skin to the periosteum is estimated and when, after repeated attempts, the needle seems to perforate a membrane, advance farther than before, and still not encounter bony resistance, it has passed into the foramen. It is unusual to insert the needle directly into the foramen at the first attempt. If this does occur, it is probably better to withdraw the needle, direct it somewhat more obliquely and locate the margin of the bone more superficially. It is thus verified that the first position was correct, and it only remains to reinsert the needle in the original location.

The needle in the foramen is usually left in place to serve as a guide while search is made for the third foramen. A 5-centimeter needle is employed for the three lower foramina. After injecting the third and fourth foramina the 10-centimeter needle is inserted into the first foramen. This foramen lies deepest of all and prolonged search is often necessary for its location. In order that the needle may advance perpendicular to the plane of the sacrum, it must be inclined more to the skin surface than in the other foramina. After the upper four foramina have been injected, those of the other side are located and injected in the same manner. When both sides have been injected the skin over the coccyx is tested for anæsthesia with a clamp. If it is insensible to pain, the fifth sacral foramina are not injected; otherwise, they are injected in the manner already described.

In transsacral anæsthesia, more than in any other nerve block technique, it is necessary to have a men al picture of the topographic anatomy of the region. It requires practice and patience for mastery and may seem difficult to acquire and to execute (11), if the operator is unable to visualize the framework through the soft overlying structures. Faulty technique may rapidly be improved by practice on the human skeleton and cadaver. It is important to remember that the sacrum is greatly curved toward its base so that

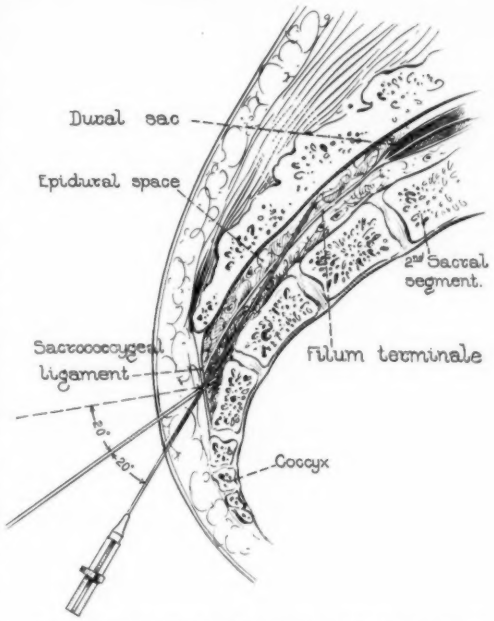

Fig. 7. Longitudinal median section of the lower sacrum and surrounding tissues showing technique of epidural injection. (After Cathelin).

in searching for the higher foramina, the thickness of the overlying soft tissues is much greater. The needle should always be advanced perpendicularly to the tangent of the sacrum at the foramen under consideration, which means that there will be the greatest obliquity to the surface of the skin in searching for the first foramen, less for the second, and scarcely any at all in the three lower foramina. Lateral inclination of the needle should be guarded against, as after osseous contact the needle may be directed more laterally and pass entirely off of the sacrum (Fig. 10). Location of the foramina by means of a system of lines and measurements as practiced by Pauchet and Sherwood-Dunn, we have found to be impractical and at times, inaccurate. The posterior superior spines and the sacral cornua are the most prominent landmarks even in obese subjects, and calculations based on less definite bony points must be correspondingly less accurate.

Proper precautions must be observed in the preliminary preparation of the patient and in the technique of the nerve block so that the procedure will not be painful. A proper preliminary narcosis of morphine and scopolamine should be given when needed, the amount being determined by

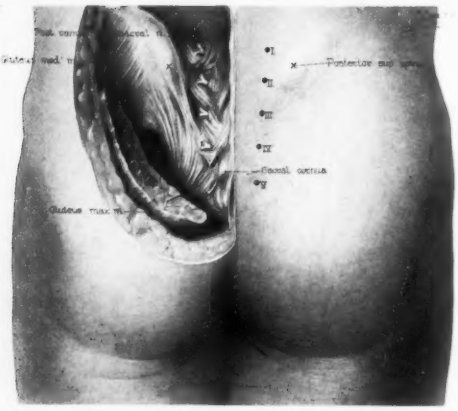

Fig. 8. Transsacral anæsthesia. On the right side note relation of cutaneous points to posterior superior spines and sacral cornu. Soft tissues have been removed on the left exposing the sacral foramina. (Modified from Pauchet.)

the age, weight, and general resistance of the patient. The dose should be sufficient to allay mental apprehension, but not to produce a state of somnolence or "twilight sleep." In many weak, debilitated, bed-ridden patients, no preliminary narcosis at all is used. For the average adult, morphine, 1/6 grain, and scopolamine, 1/300 grain, are given an hour before operation. Frequently in robust individuals of more than average weight this dose must be repeated one-half to one hour after the first administration.

The greatest pain in searching for foramina is caused by making the dermal wheals. This is but transitory and usually well tolerated. In highly sensitive individuals the point of entrance of the needle may first be anæsthetized with ethyl chloride, but this is ordinarily unnecessary. While making the initial stick the thumb should be on the plunger so that at the moment the needle enters the skin the solution can be injected. In this way the puncture is often made without the patient's knowledge. When the needles are sharp and bright there is no further pain, unless the periosteum is roughly probed. Besides causing pain this thrust also bends the point of the needle to a hook so that it tears the tissues when withdrawn and requires more force for penetration. A bent needle should be discarded immediately. Pain is occasionally produced by advancing the needle directly into a nerve trunk. The pain is shooting in character and is radiated through the pelvis to the external genitalia or down the thigh, according to the nerve trunk reached. When this occurs the needle should be withdrawn 1 or 2 millimeters so that a perineural and not an endoneural injection will be made. An endoneural injection of a large nerve trunk with the same amount of solution required for block by diffusion of the solution after perineural injection is more likely to injure the nerve trunk and result in postanæsthetic pain.

The distance for which the needle should be introduced into the foramina varies. The sacrum diminishes in anteroposterior diameter from above downward (Fig. 11). The average length of the first sacral foramen is 2.5 centimeters, the second 2 centimeters, the third 1.5 centimeters, the fourth 0.5 to 0.7 centimeter, and the last 0.3 to 0.5 centimeter. It is desirable to make the injection anterior to the midpoint of the foramina, withdrawing the needle somewhat during the progress of the injection.

The amount and strength of the procaine-epinephrin solution employed varies with the size and general resistance of the patient. For greatly debilitated patients, and for relatively poor surgical risks, a solution of 0.5 per cent strength is used. The amount is then gauged more or less on the probable size of the sacrum. From 20 to 40 cubic centimeters of the solution are injected into the sacral canal, then the sacral foramina are injected according to their size and the size of the nerve trunk to be blocked. The greatest amount should thus be injected into the first foramen and the quantity for each successive foramen reduced by 1 cubic centimeter, that is, 7, 6, 5, 4, and 3 cubic centimeters respectively. From 75 to 140 cubic centimeters of the 0.5 per cent solution has given uniformly complete anæsthesia. When 1 per cent is employed in robust individuals, 20 to 25 cubic centimeters are injected into the sacral canal and the posterior foramina in the same ratio as with 0.5 per cent. From 60 to 110 cubic centimeters of 1 per cent solution have in all cases produced complete physiological block. Ten minims of epinephrin for each 100 cubic centimeters of solution are used in all cases.

TWO HUNDRED TWENTY-FIVE CASES OF TRANSSACRAL NERVE BLOCK ANÆSTHESIA

From November, 1920, to May, 1922, transsacral nerve block anæsthesia has been employed in the Mayo Clinic in 225 consecutive operations on the pelvic floor and its viscera. This series does not include cases in which transsacral block has been used with lumbar paravertebral anæsthesia in resection of carcinoma high in the rectum, in vaginal hysterectomy, or those in which it was combined with abdominal wall field block for suprapubic prostatectomy. In the entire

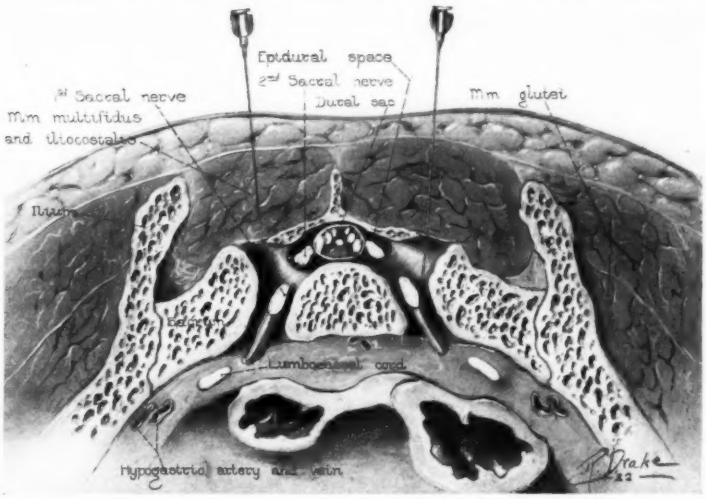

Fig. 9. Oblique cross section through the first sacral foramina (semidiagrammatic). Note slight medial inclination of needles which are in proper position for injections nto the foramina.

series preliminary narcosis was very light, often exerting no noticeable effect. Anæsthesia was complete in 222 cases, while some pain was experienced at operation in three cases, although inhalation narcosis was not resorted to. In these three cases 0.5 per cent solution was employed, which probably was not strong enough.

In the selection of this series of cases no effort has been made to assign one particular type of operation to this method of anæsthesia. During the same interval, many other operations of the type herein represented have been performed under other methods of anæsthesia, and no absolute contra-indications to the use of general narcosis have existed. It is interesting, however, to note some of the relative indications for local anæsthesia. Twenty-one patients had a "cold" on the morning of the operation. Transsacral block was used for the second operation in forty-one patients in the hospital convalescing from laparotomies. Thirty-two patients were given local anæsthesia because of their poor general condition, due to senility, arteriosclerosis, and varying degrees of chronic nephritis and myocarditis. There were two diabetics who were sugar-free at the time of operation. There were five cases of marked anæmia, two of pernicious, and three of severe secondary anæmia; all these patients had had previous transfusions. Six patients were obese women, each weighing more than 200 pounds. The list also includes five patients with clinical pulmonary tuberculosis, in two the condition was diagnosed as active at the time of operation. Only sixteen patients of the series had requested local anæsthesia.

Complications and after-effects have been few and of no serious concern. There were no post-operative pulmonary complications and no deaths in the entire series. Twenty-four patients had to be catheterized after operation (about 8 per cent), and twenty patients had retention catheters inserted at operation. Vomiting did not occur either during or after operation and in most instances the patient was immediately placed on a normal diet. In the more severe cases diet was restored progressively in from one to three days after operation, depending on the general condition of the patient and type of operation performed. Stimulating drinks, such as tea and coffee, may be administered immediately after operation.

Complications referable to the anæsthesia are tenderness over the sacrum and mild toxic symptoms. In about 15 per cent of cases there has been soreness and tenderness over the sacrum for the first two to four days. This was at times so distressing as to cause the patient to lie on his side. No special care, such as applications and dressings or the use of air cushions, has been given the sacral region after anæsthesia. There have been no cases of infection in the sacral region.

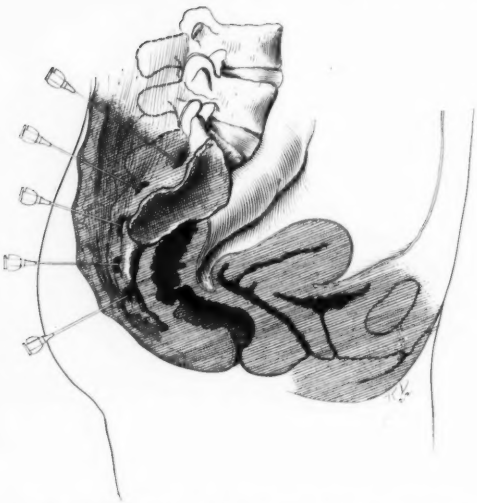

Fig. 10. Median longitudinal section of the pelvis anterior to the sacrum, with the entire sacrum preserved. The shaded portion represents the anæsthetic area, which should also include the medial surface of the thigh and buttock. Note the variable thickness of tissues over the sacrum, and different direction of needles in entering different foramina. (Modified from Pauchet.)

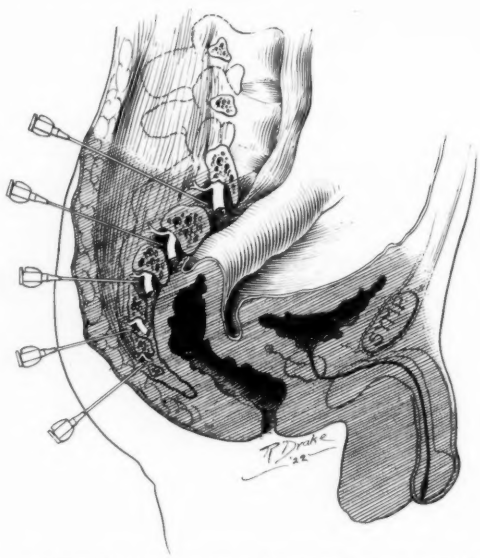

Fig. 11. Median longitudinal section of pelvis anterior to sacrum and oblique longitudinal section through the right sacral foramina. Note progressively decreasing length and diameter of the foramina from above downward and the decreasing size of the nerve trunks. Anæsthetized area of the pelvis is shaded, but as in Figure 10 it should also include the medial surface of the thigh and buttock. (Modified from Pauchet.)

Toxic symptoms when they occur, are mild and of no consequence. They consist of pallor, palpitation, perspiration, and sometimes a feeling of giddiness. When dealing with such mild symptoms it is not always easy to differentiate nervousness and toxicity. There have been no cases of vomiting, rigors, convulsions, syncope, or collapse. One patient, while on the operating table, developed symptoms of fast thready pulse, ashen facies, and cold clammy sweat, but responded to hypodermic stimulation of sparteine, strychnine and caffeine. A laparotomy had been performed two weeks previously, after which he had been unable to be out of bed. It is probable that his extreme weakness and poor general condition may have been important factors in the production of symptoms.

The extent of anæsthesia by block of the sacral nerves is best appreciated by a consideration of the variety of operations that have been painlessly performed under it (Figs. 10 and 11). In surgery of the rectum it has been employed in hæmorrhoidectomy, the usual type of operation being clamp and cautery of internal hæmorrhoids and excision and suture of external hæmorrhoids. Relaxation of the sphincters and muscles of the pelvic diaphragm are features especially favorable to surgery of the terminal rectum. Plastic operations on the anal sphincters, removal of rectal polyps, amputation of the prolapsed rectum, dilatation of rectal strictures, and excision of specimens from rectal tumors for diagnosis have been repeatedly performed under sacral nerve block. It has also been employed in posterior resections of cancer low in the rectum with removal of the coccyx and fifth sacral segment. It is usual in resection of cancers higher in the rectum to block the three lower lumbar nerves as well, although carcinomatous growths 5 centimeters from the anus have been painlessly removed under sacral nerve block alone. Both the single-stage resections with sacral anus and the two-stage resections after preliminary colostomy have been performed (31).

Gynecological operations have included perineorrhaphies, the Bovée operation for cystocele, trachelorrhaphy, dilatation and curettage, removal of cervical polyps, dilatation of the vagina in vaginismus, vaginectomy, excision of vaginal tumors, and removal of cancer of the rectovaginal septum. External urethrotomy and plastic repair of perineal urinary fistula have been performed in the male. The anæsthesia is also sufficient for

perineal prostatectomy, although it has not been employed in this operation at the Clinic. Multiple infected perineal sinuses and postanal pilonidal cysts have been excised and the coccyx removed for coccygodynia. In urology it has been employed for anæsthesia of the bladder, prostate, and urethra after epidural anæsthesia alone has been found insufficient. For more superficial work on the perineum, as hæmorrhoidectomy, anal fissures, plastic work on the anal sphincter, and anal fistula, block of the four lower sacral nerves alone is sufficient. For operations involving deeper structures, as resection of the rectum, vaginectomy, perineorrhaphy, operations on the cervix, and prostatectomy, all five sacral nerves are blocked.

The extent of anæsthesia involves the entire pelvic floor and all structures lying below the pelvic peritoneum. The more dependent part of the pelvic peritoneum is also anæsthetized, so that it may be opened painlessly; but any great pull on it may be transmitted outside of the area of anæsthesia and produce pain. For this reason the anæsthesia is insufficient for a resection of cancer high in the rectum, for vaginal hysterectomy, or for the Watkins interposition operation.

Contra-indications to transsacral nerve block anæsthesia include deformities and anomalies of the sacrum in which it is impossible to enter the foramina. Only two such cases have been found. It should not be attempted in suppurative infection of the skin and subcutaneous tissues of the sacral region because of the risk of spreading infection. In three cases transsacral anæsthesia was not attempted because of this condition. Malignant disease of the sacrum and overlying tissues should also constitute a contra-indication. Although obese, very nervous, and hysterical patients are difficult to handle, transsacral nerve block is not contra-indicated in these patients.

SUMMARY

1. The efficiency of nerve block anæsthesia can be determined only in the absence of deep preliminary narcosis, terminal infiltration, and inhalation anæsthesia.

2. Transsacral nerve block with a low epidural injection gives absolute anæsthesia of the pelvic floor and viscera in practically 100 per cent of cases.

3. The technique requires practice and patience for mastery, but may be rapidly improved by experience on the human cadaver and skeleton.

4. The difficulty of execution of nerve block and the delay in the appearance of anæsthesia may be obviated by having the anæsthesia induced in a separate room especially equipped for the purpose and the injections performed by one especially skilled in this branch of work.

5. The amount and strength of the anæsthetic solution employed should be in proportion to the general condition of the patient and the probable size of the sacral foramina and nerve trunks.

6. In addition to its high degree of safety to the patient, t anssacral anæsthesia creates as favorable an operative condition for the surgeon as general narcosis. The bother and consequent loss of the surgeon's time during operation when local infiltration is employed is thus avoided. Many operations have been performed under this method which would have been impossible with peripheral infiltration or the field block methods.

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PELVIC MEASUREMENTS BY X-RAY[1]

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In 1921, Chamberlain and Newell published in detail a method of pelvimetry by means of roentgen-ray which they had developed in the department of roentgenology at Stanford University Hospital. This method is a simplification of the method published by Runge and Gruenhagen in 1915 with the use of the stereoscope as recommended by Manges in 1912.

The distinctive points in the new technique consist first, in the use of a plumb-bob hanging from a lead ring under the target which is set 80 centimeters above the plane of the film; second, a wire stretched across under the patient; and third, a 10 centimeter rod which is placed on the body of the patient just above the symphysis.

For taking the stereoscopic plates the patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target (Fig. 1). This is accomplished by tilting the tube-holder until the shadows of the plumb-bob and the lead ring are concentric. The tube is brought over the right iliac region and an exposure made with the Coolidge tube about 15 seconds at 25 milliamperes at a nine-inch gap. The tube is then shifted 10 centimeters to the left, parallel to the wire above mentioned, and another film is exposed. When dry, the films are placed in the stereoscope, and the desired points to be measured are marked with a small ink dot. Then, on the light box a piece of clear celluloid is laid over one of the films and on it are marked, first, two dashes over the shadow of the wire; second, the center of the plumb-bob; and third, the points on the pelvis which are to be measured, labeling each pair. The celluloid is then laid over the other film, setting the dashes over the shadow of the wire, and the mark for the plumb-bob placed exactly 10 centimeters from the first plumb-bob shadow. The points in the pelvis are then marked in their new positions and lines are drawn connecting the plumb-bob dots with the pelvis dots belonging to each plate, and a third line connecting the intersections. This connecting line is marked *Y*. The line connecting the two points marking the sacrum is labeled *A* and the line connecting the two points marking the point of the promontory is labeled *B*. A centimeter scale laid on the *Y* gives the length in centimeters of the horizontal projection of the required diameter. A special scale laid on *A* and *B* gives the height in centimeters of each end of the conjugate above the plane of the film. The length of the conjugate is then computed from the formula:

$$X = \sqrt{Y^2+(A-B)^2}$$

It is not necessary for the understanding of the method to go into the mathematic computations for making the scale. But for measuring the various diameters of the pelvis it is necessary to possess a scale made according to the mathematics involved. The details of making this scale are published in the paper by Chamberlain and Newell.

To correct for errors due either to a shifting of the patient or to a wrongly made scale, one can measure the 10 centimeter rod placed on the patient. If this gives accurate measurement, then the various diameters of the pelvis will be

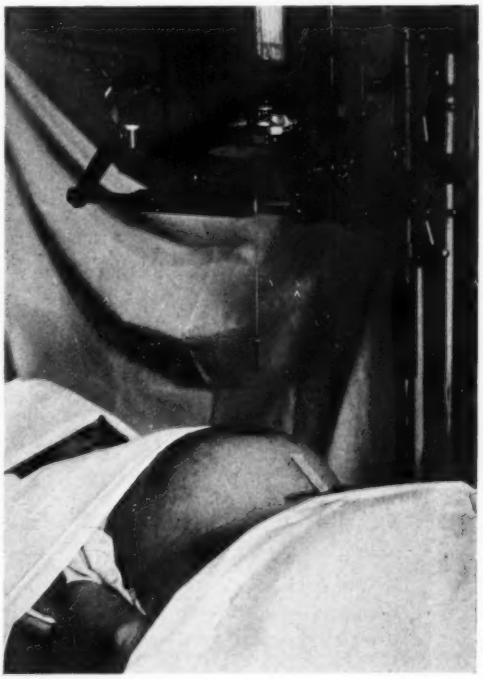

Fig. 1. The patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target.

[1] Read before the Chicago Gynecological Society, May 19, 1922. (For discussion see p. 831.)

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PELVIC MEASUREMENTS BY X-RAY[1]

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IN 1921, Chamberlain and Newell published in detail a method of pelvimetry by means of roentgen-ray which they had developed in the department of roentgenology at Stanford University Hospital. This method is a simplification of the method published by Runge and Gruenhagen in 1915 with the use of the stereoscope as recommended by Manges in 1912.

The distinctive points in the new technique consist first, in the use of a plumb-bob hanging from a lead ring under the target which is set 80 centimeters above the plane of the film; second, a wire stretched across under the patient; and third, a 10 centimeter rod which is placed on the body of the patient just above the symphysis.

For taking the stereoscopic plates the patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target (Fig. 1). This is accomplished by tilting the tube-holder until the shadows of the plumb-bob and the lead ring are concentric. The tube is brought over the right iliac region and an exposure made with the Coolidge tube about 15 seconds at 25 milliamperes at a nine-inch gap. The tube is then shifted 10 centimeters to the left, parallel to the wire above mentioned, and another film is exposed. When dry, the films are placed in the stereoscope, and the desired points to be measured are marked with a small ink dot. Then, on the light box a piece of clear celluloid is laid over one of the films and on it are marked, first, two dashes over the shadow of the wire; second, the center of the plumb-bob; and third, the points on the pelvis which are to be measured, labeling each pair. The celluloid is then laid over the other film, setting the dashes over the shadow of the wire, and the mark for the plumb-bob placed exactly 10 centimeters from the first plumb-bob shadow. The points in the pelvis are then marked in their new positions and lines are drawn connecting the plumb-bob dots with the pelvis dots belonging to each plate, and a third line connecting the intersections. This connecting line is marked *Y*. The line connecting the two points marking the sacrum is labeled *A* and the line connecting the two points marking the point of the promontory is labeled *B*. A centimeter scale laid on the *Y* gives the length in centimeters of the horizontal projection of the required diameter. A special scale laid on *A* and *B* gives the height in centimeters of each end of the conjugate above the plane of the film. The length of the conjugate is then computed from the formula:

$$X = \sqrt{Y^2 + (A - B)^2}$$

It is not necessary for the understanding of the method to go into the mathematic computations for making the scale. But for measuring the various diameters of the pelvis it is necessary to possess a scale made according to the mathematics involved. The details of making this scale are published in the paper by Chamberlain and Newell.

To correct for errors due either to a shifting of the patient or to a wrongly made scale, one can measure the 10 centimeter rod placed on the patient. If this gives accurate measurement, then the various diameters of the pelvis will be

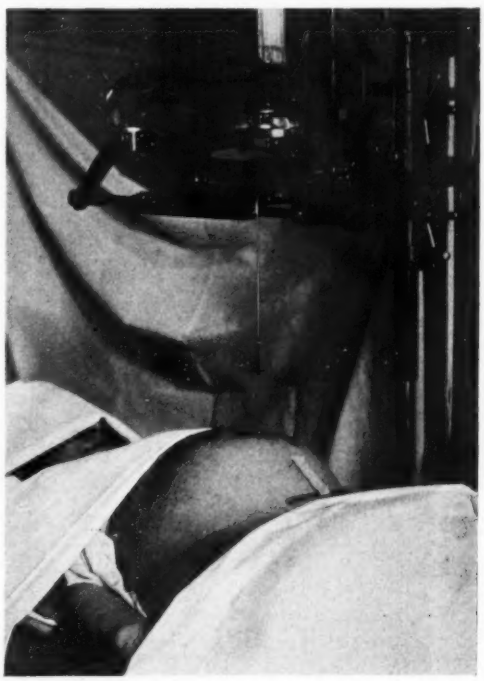

Fig. 1. The patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target.

[1] Read before the Chicago Gynecological Society, May 19, 1922. (For discussion see p. 831.)

TABLE I.—Summary of fourteen patients measured by roentgenologist.

	Type of Labor	Pelvimeter								Roentgen Ray									Remarks
										Inlet				Spines		Outlet			
		SP	CR	T	LO	EC	RO	BI	PS	AP	T	LO	RO	AP	T	AP	BI	AS	PS	
1	Breech Term	26^{6}	28	31	22^{5}	20	22	9		12^{5}	13^{3}	12^{2}	12^{8}	12^{3}	10^{5}	10^{6}	9^{7}	7^{1}	8^{1}	
2	Spontaneous Term	26^{5}	30	35	25	23	25	9		12^{4}	14^{9}	13^{4}	13^{1}	13^{4}	12	13^{3}	10^{2}	5^{1}	9^{2}	Justomajor
3	Spontaneous Term	26	30	32	24	21	23^{5}	7	8	13	13^{6}	14^{1}	13^{9}	13^{5}	10^{1}	12	7^{7}	4^{7}	11	Clinical diagnosis, funnel pelvis
4	Transverse Version	26	28	31	23	20	23	8^{5}		11^{6}	12^{2}	11^{2}	11^{8}	11^{5}	8^{4}	9	7^{6}	5	7^{1}	Funnel pelvis
5	Breech Term	24	27	34	24	20	24	7	9^{2}	12^{2}	13^{5}	12^{6}	12^{6}	12^{5}	11^{3}	12	9^{8}	5^{6}	9^{2}	Clinical diagnosis, funnel pelvis
6	Breech Term	26	28	33^{5}	22^{5}	19^{6}	23	7^{5}	9^{5}	11^{6}	13^{5}	13^{2}	12^{8}	11^{5}	9^{3}	10^{6}	8^{4}	5^{4}	9^{7}	Clinical diagnosis, funnel pelvis
7	Breech Term	27	29^{5}	32^{5}	23	19^{5}	22	8^{5}		11^{5}	14^{3}	13^{5}	14	13^{3}	11^{2}	12	8^{3}	6^{7}	9^{3}	
8	Mid-Forceps Term	22	24	27	21	19	21	6	8^{5}	11^{5}	12^{9}	12^{2}	12^{5}	12^{2}	10	11	6^{5}	5	9^{7}	Clinical diagnosis, funnel pelvis
9	Bags Mid-Forceps Term	23^{5}	26^{5}	30	22	20^{5}	22^{5}	7		12^{9}	13^{2}	12	12^{5}	11	9^{6}	8^{2}	7^{7}	4^{2}	8^{7}	Clinical diagnosis, funnel pelvis
10	Spontaneous Term	21^{5}	26	38	21^{5}	19	22^{5}	8		12	13^{3}	12^{1}	12^{3}	10^{6}	9^{5}	9^{6}	8^{4}	5^{1}	8^{8}	
11	Low-Forceps Term	25^{5}	28	32^{5}	25	21	25	7	9	13^{1}	14	12^{8}	13^{9}	11^{9}	10^{3}	10	9	6^{2}	9^{7}	Clinical diagnosis, funnel pelvis
12	Cæsarean Eclampsia	25	28	32	24	19	23	7	6^{5}	12^{4}	13^{3}	14	13^{5}	10^{7}	9^{7}	10^{1}	9^{4}	6^{2}	6^{6}	Clinical diagnosis, funnel pelvis
13	Cæsarean after 12 Hrs. Labor	26^{5}	27	32	21	17	21	9	7	8	14^{3}	11^{5}	13	10^{1}	11^{3}	9^{5}	9^{3}	7^{2}	8^{9}	Rachitic flat D.C. 10 Est. T.C. 8^{5}
14	Cæsarean 2nd	25	27	31	21	18	21	8		10^{2}	12^{1}	12	12^{5}			9^{5}	10^{3}			Flat pelvis; 1st at N. Y. Lying-In

TABLE II.—Comparison of pelvic measurements by pelvimeter and roentgenologist. 1 and 2, by roentgenologist. A to L, by clinical staff with pelvimeter.

	I. S.	I. C.	B. T.	L. O.	E. C.	R. O.	B. I.	P. S.
X-ray 1	19.1	24.0	28.1	20.0	18.2	20.0	8.9	9.0
X-ray 2	19.6	23.3	27.2	18.5	17.3	18.1	10.3	7.4
A	19.75	24.75	28.5	18.5	17.75	19.0	9.25	7.0
B	21.25	25.5	28.5	20.75	18.5	21.0	9.5	6.0
C	21.0	25.5	30.0	20.0	18.0	20.25	8.5	8.0
D	21.0	25.0	29.5	20.5	19.0	20.5	9.0	7.0
E	21.5	26.0	....	20.0	18.5	20.5	9.0	7.0
F	20.5	26.0	30.0	22.5	17.25	23.0	11.0	8.75
G	22.5	25.5	29.0	20.0	18.5	21.0	8.75	6.25
H	21.5	25.75	29.5	20.5	19.0	21.25	9.0	6.5
I	22.0	26.0	29.5	21.0	19.75	21.0	8.75	7.0
J	21.0	25.5	28.5	20.0	18.0	21.0	9.0	7.0
K	21.5	26.0	....	20.5	20.75	20.75	10.5	7.5
L	21.0	26.0	....	20.0	21.0	21.25	10.25	6.5

accurate, providing the dots have been accurately placed on the plates. This is the one point in the method which depends upon individual technique for accurate mensuration. In measuring dried pelves the method has been found to be accurate within 2 millimeters.

The method is too expensive to be used as a measure of routine, but we have found it very helpful in cases with suspected abnormalities of the pelvis detected either with the usual methods of pelvimetry or from an abnormal progress in labor. Particularly has it been helpful in gauging more accurately the diameters of the outlet of the pelvis, and in two instances has been the deciding factor in inducing labor rather than resorting to a preliminary cæsarean section. In both instances the outcome of the labor proved the accuracy of the X-ray measurements. A summary of fourteen patients so measured is given in Table I. We have not utilized so far cephalic measurements, but with greater experience it does not seem unjustifiable to expect that with this method we should not be able to judge correctly the proper time for inducing labor in patients with moderate degrees of pelvic contraction.

In a marked obliquely contracted pelvis the impression given by external measurements was entirely changed by the accurate measurements for both oblique diameters which were found to be nearly equal.

An additional practical point that we have observed in the use of the X-ray measurements during the progress of a delayed labor is the accurate diagnosing of the position of the presenting part which is shown by the X-ray photograph.

It is more difficult for the roentgenologist to place the points accurately for external measurements because of the shadows of the iliac bones, but the method has great teaching value in correlating the various methods of external pelvimetry used by different members of the staff. This has been tested in a very interesting contest where the entire staff, including the attending obstetricians, senior house staff, junior house staff, and students have entered into a competition with the X-ray department. In this contest not only was the fact brought out that certain of the pelvimeters in regular use gave erroneous measurements, but also that different methods for measuring the pelvis showed quite varying degrees of accuracy (see Table II).

Not only did the measurements made by the clinical staff vary, but also there was a considerable variation in the two measurements made by different roentgenologists. At first glance, this might seem to throw doubt on the value of the X-ray measurements, but after considerable discussion in staff meeting, it was found on the side of the clinicians that not only were some of the instruments used defective, but also there was not a unanimity of opinion as to the exact points from which the different measurements should be taken. This was particularly noticeable in the outlet measurements of the pelvis. Because of the size of the tuberosity of the ischium, different measurements will be obtained if the bis ischial is measured from the anterior edge, the middle portion, or the posterior edge, of the tuberosity. However, it will be noted in the chart that where short bis ischial measurements are made the same individual usually measured a long posterior sagittal. The measurements made by different roentgenologists are due not to errors in the technique of the method, but rather to misunderstandings as to the exact points between which the measurements should be taken.

Moreover, the roentgenologist, unless he is also a trained obstetrician, is not capable of expressing to patients the prognosis of labor based upon X-ray measurements. So many factors must be considered in regard to prognosis such as pelvic inclination, presentation and position, mechanism of labor, etc., that the obstetrician must rely on his training and past experience in this important matter, and can utilize X-ray measurements only as one factor to aid him in arriving at his decision. It is not sufficient for the obstetrician to read merely the written report from the roentgenologist, but he must study with the roentgenologist the stereoscopic pictures of the pelvis and satisfy himself that the points from which the measurements are taken are the points which in his judgment are essential.

AN ASEPTIC METHOD OF INTESTINAL ANASTOMOSIS

An Experimental Study

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IN consequence of the lack of a satisfactory aseptic method (1) of intestinal anastomosis, and more especially because of the mortality from infection following open resection and suture of the large intestine, the present study was undertaken.

HISTORICAL

Methods and devices have been reported, which are intended to decrease the amount of soiling at the time of operation. However, it may be said that practically all of them necessitate the withdrawal of some instrument or material through the line of sutures in order to complete the anastomosis. One may mention for example, Frank's coupler (2) 1896–1899; the forceps of Laplace (3) 1898; O'Hara (4) 1900, Moszkowitz (5) 1908, and Gudin (6) 1916; Lee's holder (7) 1901; the release sutures of Pockhammer (8) 1906, Wullstein (9) 1908, and Grey (10) 1918; the elastic ligature of Silvestri and McGraw (11) 1891; and the elastic ligature and the gliding metallic draw-string of Pockhammer (8) 1906, and Werelius (12) 1906. Certain procedures have been advanced that are evidently not aseptic, but which facilitate making the anastomosis and in this way somewhat diminish the total amount of soiling. Among these may be included the Murphy metallic button (13) 1892, Abbe's catgut rings (14) 1892, Robson's (15) 1893 and Allingham's (16) 1895 decalcified bone bobbins, Halsted's inflated rubber cylinder (17) 1898, Harrington's (18) 1902 and Gould's (19) 1904 segmented rings with screw handle, Senn's bone plate (20), and other potato-, turnip-, carrot-, bread-, candy-, fibrin-, metallic-, and bone-plates, rings, buttons, cylinders, etc.

The bulkhead method, described by Dr. William Stewart Halsted (21) in 1910 and 1912, was perhaps one of the first more nearly to approach an aseptic operation. Recently (1921 and 1922) Dr. Halsted (1) reported the procedure of abutting the closed ends of the large intestine and puncturing the double diaphragm with an instrument passed per rectum.

In 1916–1917 one of us (Burket) studied various ways to lessen the amount of soiling which occurs during intestinal anastomosis. A wire loop, similar to a tonsil snare, was used to cut through the invaginated stumps of the abutted, closed ends of the intestines. This required the withdrawal of the wires through the line of sutures, and also left a long turned-in cuff of intestinal wall. When the wire was pulled out, the submucosa was occasionally dragged through the suture line and into the metallic tube through which the wire loop worked. Later an instrument was devised, which consisted of a series of knife blades, united to form a diaphragm (like the kodak iris diaphragm), which could be closed by lateral pressure. However, this instrument was difficult to maintain in position, as inserted, and also left a long flap of intestinal wall hanging within the lumen. Various release sutures were studied, but they also necessitated turning in too much intestinal wall and withdrawal of material through the suture line.

Subsequently we have developed an aseptic method of intestinal anastomosis which is dependent for success upon an instrument (Fig. 1) formed of reciprocal male and female halves.

DESCRIPTION OF INSTRUMENT

The male half of the instrument consists of a cylindrical knife blade *a* (Fig. 2), mounted at its back on a central shaft, which is threaded on the portion within and in front of the blade, in order to hold the ratchet of the female tube. A small button *a3*, to serve as a handle with which to rotate the knife, is fastened by the pin *a4* to the rear end of the shaft. The outer surface and back of the cylindrical knife are completely encased in a rigid cover *a2*. The center of the back of this protecting cover is perforated by the shaft and near the center is fastened a small rod, which extends forward through the inside of the cylindrical knife. A spring ratchet is attached to the front end of the rod.

The female half of the instrument is formed of a solid, somewhat conical-shaped structure, *b1*, which contains a projecting central metallic ratchet tube, on the upper surface of which is a metal groove to receive the male protecting-cover rod. Above the groove, within the solid part, is a threaded metallic surface *b3* on which the cover-rod ratchet catches. The female half of the instrument is composed of three distinct

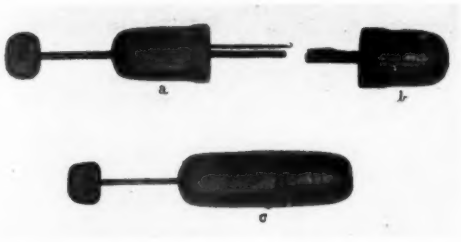

Fig. 1. *a*, Male half and *b*, female half of instrument assembled and ready to invaginate. *c*, Shows the instrument completely reciprocated together and within which only the cylindrical blade is freely movable to be rotated and advanced by means of turning the button on the end of the knife-blade shaft.

segments *b1*, *b2*, and *b3*, which articulate in such a manner that, when assembled, they can be locked immovable by means of a pin *b4*, which perforates the segments from side to side. The segments are essential in order to release the ratchets and to permit easy inspection of the threads, central tube, and groove. A pasteboard disk *b5* covers the flat hard surface of the female half in order to protect the keenness of the circular cutting edge of the male knife blade.

OPERATIVE METHOD OF INTESTINAL ANASTOMOSIS

Our aseptic method of intestinal anastomosis (Fig. 3) is as follows: The intestine is resected between two ligatures of heavy silk, with the cautery knife. Each cauterized end of intestine is invaginated like an appendix stump. The male and female halves (Fig. 1, *a* and *b*) of the instrument described, are inserted one into each gut-end at this time and help to push inward the ligated, cauterized stumps. The two parts of the instrument are so placed that, when they are fastened together, the mesenteric borders will be accurately coapted. Each half of the instrument is held in its respective gut-end by a purse-string suture, which draws a double-walled diaphragm of intestine over each part of the instrument and which is tied down on the projecting central tube, after the instrument has been pushed together just sufficiently to permit the central tube to extend under the edge of the cylindrical blade. It is well, first, to tie the purse-string suture of the female part firmly about the central tube, and then to tie that of the male part loosely around the same tube. After the diaphragms and sutures are carefully inspected to see that all is in the proper position, the halves of the instrument are reciprocated together snugly against the intervening layers of intestinal wall, without

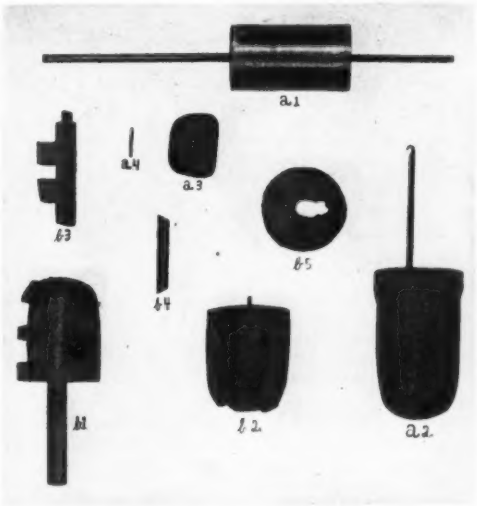

Fig. 2. Instrument unassembled.

traumatizing the gut (Fig. 3). Thus the double diaphragms of the intestinal wall are firmly fixed against the flat surface of the female portion by means of the rigid protecting cover of the cylindrical knife of the male half of the instrument. The intestines are readily anastomosed with interrupted fine black silk sutures. The instrument makes an excellent form on which to take the stitches. It is well to place but not to tie the mesenteric border mattress suture before the two halves of the instrument are ratcheted together, as it is easier at that time accurately to place the stitch, and one can thus be certain of a neat and strong approximation of the mesenteric border. After the mattress sutures have been placed and tied, the operator with his left hand gently grasps the wet cotton-covered intestine which contains the body of the instrument, and with his right hand turns the cylindrical knife by gently manipulating, through the gut wall, the button on the end of the shaft. The button is turned slightly from side to side and moved forward as the knife cuts through the intestinal diaphragms which intervene between its circular edge and the solid surface of the female part. As the knife is the only movable structure within the instrument and the gut layers are firmly fixed against the female block by the protecting cover of the knife, it cuts through the diaphragms and the hand easily detects by feeling when the knife edge reaches the resistance of the hard surface of the female part. Thereupon the instrument, as a

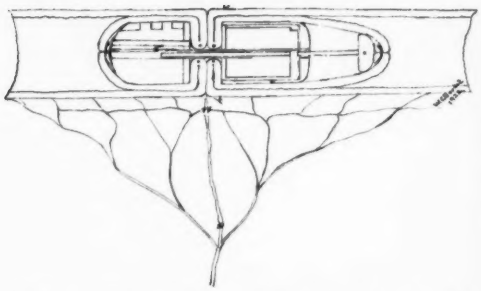

Fig. 3. Diagrammatic longitudinal section; aseptic method of intestinal anastomosis; instrument invaginated into gut ends and reciprocated together ready for intestinal suture and manipulation of cylindrical blade in order to cut out the intervening diaphragms of gut wall.

whole and covered by the invaginated portions of the intestine, slips free and may be slid along out of the gut, or to any desired distance from the field, and permitted to be expelled by the intestines. Thus is promptly re-established the lumen of the intestine, which has not been opened[1] at any time during the operation. The disk of intestinal wall that is excised by the cylindrical blade in order to re-establish the lumen is shown in Figure 4, *a* and *b*. The rent in the mesentery is closed with a running glove suture, care being taken to avoid injury to any blood vessels which may supply the region of the anastomosis. The remaining inturned intestinal collar is just the desired length and, indeed, can be made almost any length by simply turning in more gut wall by means of another anastomotic row of interrupted mattress sutures.

STUDY OF THE ASEPTIC METHOD

We have employed the above method frequently on freshly isolated pig's intestine and also, by aseptic operation, on living dogs under ether anæsthesia.

We have determined that a smooth-edged, solid, circular knife blade (Fig. 2, *a1*) cuts easily, cleanly, and uniformly against a solid surface; while an irregular, serrated, or scallop-edged knife or a series of knife blades seem to be unsatisfactory because almost invariably shreds of submucosa are dragged into the crevices of the blade. These shreds are difficult, finally to divide completely, and hence, complicate the operation.

We have other designs of instruments which work, but thus far the form described in this report is the most satisfactory. A series of different-sized instruments is at hand in order to be adaptable to intestines of varying diameter.

The method is suitable for small and large intestines.

[1] At each site of resection, the intestine is divided by the actual cautery between two tightly placed ligatures and the stumps are thoroughly cauterized during this procedure.

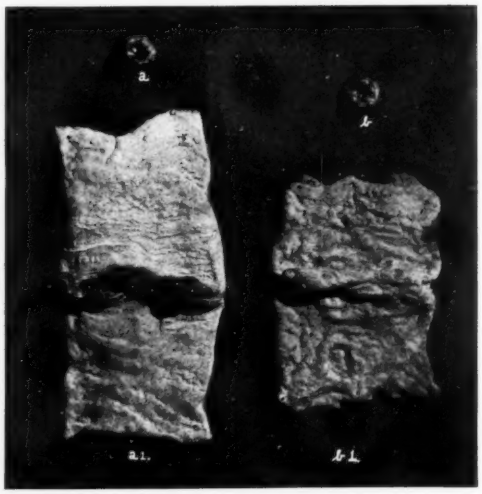

Fig. 4. Specimens of healing anastomosis from dogs that were operated upon by this method; *a1*, healing at end of seven days; *a*, shows the disk of the diaphragm of the abutted intestinal walls that was cut out by the cylindrical knife in order to re-establish the lumen in specimen *a1*, and which passed per rectum (together with the instrument) within 40 hours after operation; *b1*, healing at end of 14 days; *b*, the disk removed by the cylindrical knife from specimen *b1*, and which passed per rectum (with the instrument) within 40 hours from the time of operation.

ADVANTAGES

The advantages of this method of intestinal anastomosis are that—

1. It cuts through the closed abutted ends of the gut and promptly re-establishes the lumen without exposing the operative field to soiling from the opened intestine or by the withdrawal of any material or instrumental device through the line of sutures;

2. No mechanical device is left *in situ* to interfere with the healing (as is the case of the Murphy button). The cylindrical knife serves only as one of the temporary instruments of the operation, just as do the needles and hæmostats, and is removed from the field before the operation is completed;

3. The remaining inturned cuff of intestinal wall is a desirable length, and is neatly, sharply, and uniformly cut;

4. An anastomotic opening is obtained which closely approximates in diameter the gut lumen

and thus removes the opportunity for temporary obstruction, or too great narrowing of the lumen which results from a long inturned collar of intestines;

5. Soiling is reduced to a minimum, dependent upon the effectiveness of the cautery and the skill with which sutures are placed in the submucosa without penetrating the mucosa.

It is intended at a later date to present further studies with our aseptic method of intestinal anastomosis.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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DECEMBER, 1922

THE UNNECESSARY OPERATION

WELL-EXECUTED surgical procedures for disabling symptoms due to definite and removable causes are most brilliant and beneficent in their immediate and permanent results. There is a large group of so-called neurotic individuals who have all sorts of real and imaginary symptoms that mimic very closely every variety of organic disease. Operations, when extended to this type, have been followed by the most disappointing results. In the evolution of abdominal surgery, the ovary, the retroverted uterus, the mobile kidney, the functional stomach disorder, the colon, and the gall bladder have in turn been subjected to operation. All were of the neuropathic habitus, many had the stigmata of degeneracy and had operations chronologically on the organs in the order named for practically the same symptoms with slight variations. Surgeons found the futility of such measures and abandoned largely any operative attack upon these organs without very definite and genuine indications. There yet remain well-meaning men who lack discrimination and experience and make the error of attempting to extend operative relief to this unfortunate type of individual upon insufficient clinical data and inadequate pathological criteria. There are regrettably some unconscionable pot-hunters who will operate on anybody that will hold still. Every hospital should eliminate that kind of man.

For those possessing judgment and honesty, the ubiquitous neurotic whose complaint simulates real pathology challenges his scrutiny and restraint. Metastatic lesions are miraculously cured by the removal of real foci of infection, yet it is being notoriously misapplied and tremendously overdone. The uncured peripatetic "neuro" now commonly relates operations obviously unnecessary upon the tonsils, antra or teeth instead of decorations made by numerous abdominal incisions as formerly. The general surgeon with a wide experience in handling all types of disease has learned how to *triage* the neurotic, but the unwary and enthusiastic specialist too often subjects them to unnecessary operations for the cure of bizarre symptoms.

Dysfunction of the abdominal organs constitutes a very uncertain land of shifting sands. The neurotic condition is most persistent, resistant, and insistent. The symptoms are so vivid and the plaint is so repeated that many men fail to evaluate them correctly. The chronicity and rebelliousness of these cases make them hard to decline. A humorous publication very significantly says: "If you go to the doctor often enough you will be operated upon."

There are so many functional disorders of the digestive system, without physical lesions in the stomach itself or the satellite gall bladder and appendix, that it behooves the

examiner to be most thorough-going. It is inexcusable to overlook cardiorenal and pulmonary diseases, parasites, anæmias, disorders of the central and spinal nervous system that produce digestive symptoms. The X-ray, fortunately, can isolate practically all of the organic lesions of the stomach. The intangible nervous system that complains so bitterly is our pitfall.

Peristalsis and the secretory processes are not felt or perceived by an individual who is normally innervated. They doubtless transmit sensations to the brain that have to do with the healthful state and certainly with many abnormal states. The neurotic, however, is keenly perceptive of these sensations that are unknown to the normal individual and in him it amounts to pain. The autonomic nervous mechanism is most delicate and influences us dominantly for good or ill. The vasomotor changes on the surface of the body such as pallor, blushing, and the lesser emotions are such common evidences and yet are so striking and varied as to constitute the film of the novelist in his description of the emotional states, such as fright, pain, fear, or elation. The elder Eastman once said that when a magnet receives a powerful blow on the anvil, it ceases to magnetize, and when the nervous system of a woman receives a terrible emotional blow it ceases to function properly.

Moreover, if excessive stimulation of the sympathetic system is constantly repeated by worry, doubt, anxiety, and solicitude, the endocrine system which is dominated by the sympathetic is affected, and the condition of chronic nerve tire with its pitiable manifestations occurs. The smooth-running, physiological mechanism presided over by the sympathetic jangles "like sweet bells out of tune." It is chance whether the gastro-intestinal function is affected or the vasomotor system, or both.

The sympathetic system controlled man before the central nervous system came into being, and protected him in the primitive state from physical danger. Civilization has lessened the imminence of these dangers but substituted the more insidious and deadly danger of gruelling strenuosity and the vexatious anxiety of competitive life. The autonomic nervous system in the effort to protect man from his new enemies suffers bolshevism. It then gives rise to the various abdominal symptoms that are spoken of as vagatonia and are, when more wide-spread, denominated neuro-circulatory asthenia. They are often associated not only with abdominal and pelvic complaint but with pain referred to the head and back. These patients suffer so and their families and friends more so and over such a long time they think they have organic disease and will not be otherwise persuaded.

Introspection sometimes causes fixed ideation about disease and its seriousness, and requires the most clear-visioned, skillful and sympathetic medical management rather than surgical exploitation. Instead the surgeon is often importuned. The cases are frequently referred by the most accomplished diagnosticians who eliminate every possible source of demonstrable disease by a complete examination but assume there must be some organic trouble failing, as they do, in the final analysis to interpret the interplay of the nervous system. The organ of course that is blamed the most is the appendix and while fortunately it can be spared, an unnecessary operation, even upon that organ, is not an unmixed blessing and is often unavailing and discouraging. Seemingly satisfactory results are apparently obtained occasionally but it must be realized by thoughtful men that they are purely the result of suggestion. Surgery is a very dangerous type of suggestive therapeutics. Chronic appendicitis is so easy to say and still means

so little. If it means anything in the history of a patient it means that it was probably an unnecessary operation upon a neurasthenic. It is never diagnosed in patients with a normal nervous system. Occasionally one will be beguiled into operating upon these patients and greatly mortified to find a small, cord-like, white, obliterative appendix that certainly is incapable of producing symptoms. We have little reason for diagnosing chronic appendicitis in the absence of definite acute or subacute attacks. Renal and ureteral stone often masquerade as appendicitis. Surgeons are most astute in the elimination and detection of a demonstrable disease. The place they fail is in operating upon people who have no organic disease, but make a noise like they really had, but we can't always diagnose that he hasn't anything. It is lamentable that a considerable number of people have had unnecessary operations upon the lowly appendix and other normal organs without benefit. The patient with a throbbing abdominal aorta or blood pressure of 100, should have no surgery that is not imperative. The thin asthenic, ptotic woman may and can have organic disease but she is the vamp of the diagnostician and the lure of the surgeon.

WILLIAM D. HAGGARD.

RELATIONSHIP BETWEEN THE ILEOCÆCAL COIL AND ARTHRITIS DEFORMANS

CHRONIC polyarthritis in our opinion has its origin in a focal infection in the intestinal tract, due to an unbalanced or perverted intestinal flora, made possible by the failure of some part of the ileocæcal coil to empty itself properly. From the careful and repeated X-ray examination of one hundred cases of arthritis and the abdominal operative findings in sixty cases, we have been able to draw some very definite conclusions as to the existence of an intestinal focus of infection, the nature of the intestinal deformity, and the method of its production.

Infections of the teeth and tonsils are undoubtedly the cause of many cases of acute arthritis, and their removal quickly clears up the symptoms. But in chronic cases, the removal of tonsils and teeth has, as a rule, very little permanent effect, the reason being that an intestinal infection has taken place and a larger focus developed, so that then the clearing up of the head foci hardly affects the load of infection at all.

The similarity of the picture of the ileocæcal coil in all of these cases has led us to the conclusion that the typical soil for development of arthritis is a congenitally mobile cæcum which has been tacked back to the side wall of the abdomen by nature in an effort to lift up and anchor a prolapsing organ.

By a reduplication of peritoneum starting at the right colic artery and extending to the parietal peritoneum over the right kidney, the colon is rolled and folded so that it gives the appearance of an hour glass, with the cæcum thin walled and toneless. There is usually a binding down of the ileum somewhere in its terminal 8 inches (20 centimeters), increasing the torsion in the ascending colon so that the physiological function of the colon is crippled and the cæcum becomes an inert sac, which does not empty itself. This sac constantly filled with culture medium becomes infected with streptococcus, either from a head infection or from the terminal ileum, which is the natural habitat of the *streptococcus viridans*. The streptococcus becomes then the predominating colon organism and we have an overbalanced flora resulting, which, in its turn, becomes the focus of infection that keeps up the arthritic disease.

The most striking results following the removal of the right colon have proven to us

the colonic origin of the disease. The removal of the right colon deprives the patient of his filter and for 10 days there is practically no water absorbed by the intestinal tract. It becomes necessary to give this patient water under the skin in order to prevent dehydration. Our routine consists of giving a quart (1 liter) of salt solution daily by hypodermoclysis until the quantity of urine increases from 1,000 to 2,000 cubic centimeters. This happens usually from the tenth to the twelfth day. During this ten-day period the patient makes a wonderful recovery from joint trouble. In from 48 to 72 hours, the swelling disappears and the joints become more and more movable and the pain entirely disappears; but on the day the quantity of urine doubles, showing that the intestinal tract is again absorbing water, the symptoms recur. The perverted flora is still able to act as a focal infection and the joints then clear up slowly as the flora returns to normal. The removal of the right colon, however, in debilitated patients is rather a formidable procedure and we have endeavored to develop a method of restoring the physiological function of the crippled cæcum without its removal.

The interference with physiological function of the cæcum is easily demonstrated by dividing the constricting band with a sharp knife at its junction with the parietal peritoneum. The ascending colon immediately rolls out until 3 or 4 inches (7.6 or 10 centimeters) separate the ends of the divided band, and the cæcum regains its normal color and contracts on mechanical stimulation. We believe that the interposition of tissue is the most important step in preventing recurrence, and we use free omental grafts to fill in all gaps and cover all denuded surfaces.

We have found the unpuckered mesoappendix, spread out and turned over toward the midline, most useful in covering the denuded surface developing on the mesentery of the ileum after the division of a "Lane's kink," and we believe that again the interposition of tissue is most important in preventing a recontraction of peritoneal surfaces and a redevelopment of the kink.

If there is no mechanical intestinal abnormality, but instead a general colon sluggishness, the after surgical treatment designed to re-establish a normal intestinal flora, without surgery, will produce the same result. We have, in a number of cases, obtained great symptomatic improvement by this treatment without any surgical procedure. Other patients, treated medically without any improvement, have had an immediate relief of symptoms following a surgical procedure to remove the intestinal blockade, after which the same medical régime was resumed.

The joints become amenable to orthopedic treatment as soon as the pain subsides, and operations and manipulations can be carried out without fear of lighting up another attack of acute inflammation, which always hampers the orthopedic surgeon when he attempts any radical procedure in the presence of the infection. REA SMITH.

MASTER SURGEONS OF AMERICA

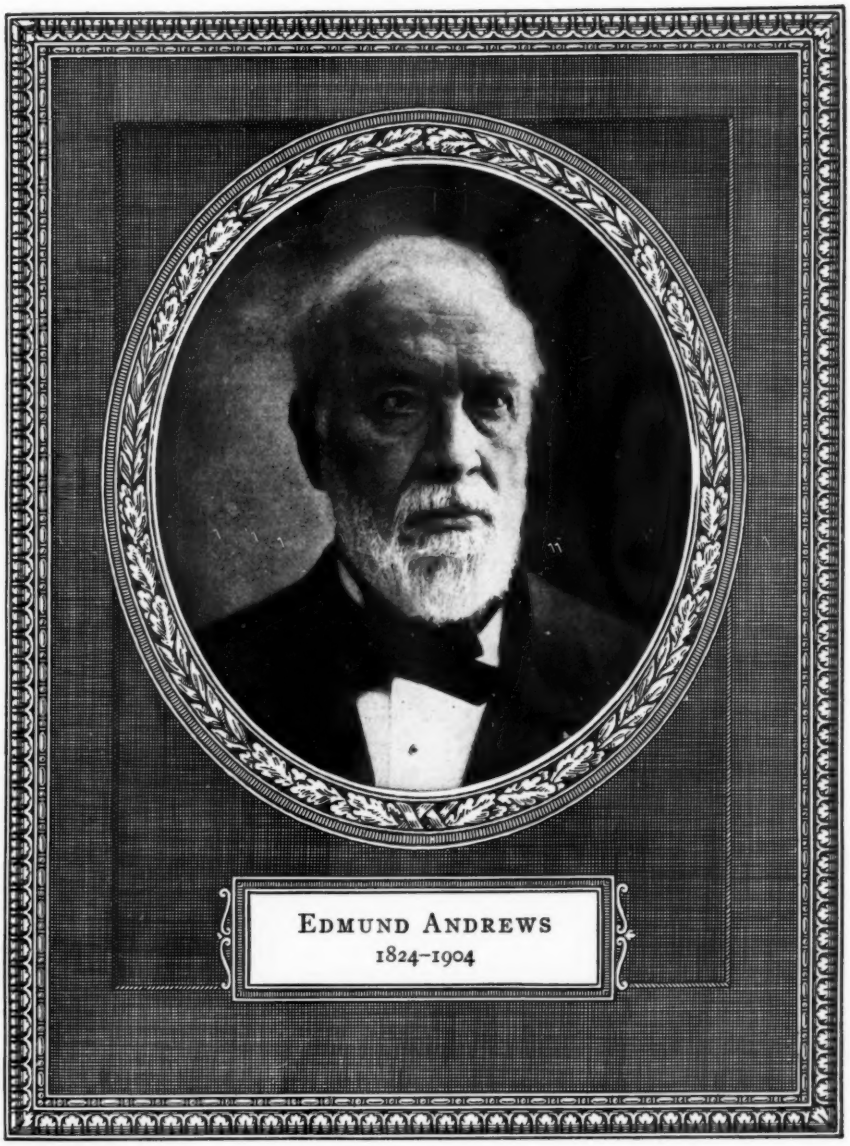
EDMUND ANDREWS

DR. ANDREWS was born in Putney, Vermont, in 1824, and died in Chicago, in 1904. His father was the Rev. Dr. E. D. Andrews, a Congregational minister, and his mother, Mrs. Andrews (née Lathrop), was the daughter of a physician. The family history shows an unbroken line of American-born ancestors dating back to 1728. His grandfather was a soldier in the Revolutionary War. A brother of Edmund was a medical missionary in Hawaii and a graduate of Dartmouth. This brother was the father of the late Dr. George P. Andrews, sometime dean of the Detroit Medical College and professor of medicine in that institution. Another brother was a federal judge in Knoxville, Tennessee.

In the early days and especially in rural communities, the meagerness of the salary of a minister of the Gospel made it necessary for him to employ additional measures of support, and young Andrews from early boyhood, became inured to the hardy discipline of his father's farm. But this was never allowed to interfere with attendance at the best schools in the neighborhood, and on occasions home instruction was given as well. He describes himself at this period of life as a great straddle-legged rustic who had not achieved noticeable popularity as a beau. Loss of voice compelled the father to withdraw from the ministry, and, after several smaller changes in location, in 1841 the family moved to Armada, Michigan, and there proceeded to carve a fine farm out of the primeval forest. Meantime young Andrews was kept at his studies as diligently as possible, and his preparatory work was so well accomplished in the Academy of Romeo, Michigan, that in 1846 he was admitted to the sophomore class of the University of Michigan, which just then had opened its doors.

During his career as a student he manifested a decided preference for the scientific studies, and this preference dominated his activities throughout life. While attending his class work he helped out his expenses by teaching vocal music and leading the church choir.

He received his bachelor's degree in 1849 and in 1850 entered the medical Department of the University which that year opened its doors for the first time. In 1852, he received his medical degree and also his master's degree, and in 1881 his Alma Mater conferred upon him the final degree of LL.D.



EDMUND ANDREWS
1824–1904

Immediately after his graduation Dr. Andrews was elected demonstrator of anatomy in his Alma Mater and a year later was made professor of comparative anatomy. In 1856 he came to Chicago to accept the demonstratorship of anatomy in the Rush Medical College, but he soon found this position to be uncongenial and relinquished it.

While still connected with the University of Michigan the young philosopher had published several essays in the medical periodicals of the country, in which he advocated a graded system of medical teaching and the requirement for admission to medical colleges of a respectable measure of preliminary scholarship. It was, therefore, easy and natural for young Andrews to join with N. S. Davis, H. A. Johnson and other physicians of like spirit, in founding the Chicago Medical College, which was the first medical college in the United States to adopt a graded system of instruction. Dr. Andrews occupied the chair of surgery and clinical surgery in this institution for many years.

When Dr. Andrews came to Chicago he left behind him in Michigan two remembrancers: The Michigan State Medical Society, of which he was one of the organizers, and the *Peninsular Journal of Medicine and the Collateral Sciences*, of which he was one of the founders.

Early in the Civil War, Dr. Andrews was appointed surgeon-in-chief of Camp Douglas in Chicago, then a training camp for state troops; but soon after he was appointed to the Federal Service as surgeon of the First Illinois Light Artillery, and served in the campaigns against Shiloh, Corinth, and Vicksburg. After some months of hard service he contracted dysentery which, continuing without check or abatement, finally became so severe as to imperil his life and compel him to withdraw from the service. Full recovery required a year and a half of careful treatment after his return to Chicago.

During his military service he was the first to keep systematic records of army cases of disease and injury. His reports to the Surgeon General have been used as the basis on which the records of the office of the Surgeon General have since been kept. Some time after his withdrawal from the army, Dr. Andrews published a very extensive essay on military statistics, which was accepted by later writers as authoritative for many years.

He visited Europe in 1866 and spent his time mostly in the hospitals of Paris and London. He was powerfully impressed by the teachings of Lister.

One of the most notable of Dr. Andrews' labors was the study of the relative dangers attending the induction of anæsthesia by chloroform, ether, nitrous oxide, and a mixture of chloroform, ether and alcohol. His conclusions, based on the analysis of hundreds of thousands of cases, were quoted as authoritative in current and textbook literature for many years thereafter. A fact not generally known is that Dr. Andrews was the first to test, and to write on "Gas-Oxygen Anæsthesia."

In *Science*, August, 1911, Professor Charles Baskerville of the College of New York, refers to the experiments of Dr. Andrews in 1868 with a mixture of oxygen and nitrous oxide to produce a non-asphyxial anæsthesia and then says: "Although Andrews published accounts of several cases in which the mixture had produced more satisfactory anæsthesia than the nitrous oxide alone, his observations failed to attract the attention they deserved,"—obviously because the accounts had not been published in a medical journal at all but in a science magazine.

There was very little unemployed time in Dr. Andrews' life. He was a tireless investigator. Recreation was sought in the wilds of nature. His frequent excursions to mountains and forests and rocky islands and lakes and rivers, although they furnished boundless delight and begat an exaltation of spirit in the contemplation of the grandeur and sublimity of nature's works that was very near to worship, had other objects in view. They were used in the observation of countless botanical, zoological and geological facts. The museum of the University of Michigan and the Chicago Academy of Science bear eloquent testimony to this effect.

Dr. Andrews was one of the founders of the Chicago Academy of Science and served for many years as its president. There were coadjutors and noble financial supporters. But through lean and fainting years, through years of discouragement and years of disaster and years of almost complete abandonment, it was Edmund Andrews and, at times he almost alone, who held fast the self-sacrificing courage of love and duty. It is now a noble monument—the repository of matchless treasures; but the noblest thing it can show is the story of its struggle for existence, and in that story the name of Edmund Andrews will forever be the lustrous feature.

As a surgeon Dr. Andrews was always in the forefront of progress. Of mechanical bent he originated a number of orthopedic appliances and other instruments which contributed to the growth and precision of the mechanics of surgery. For many years he was the only surgeon in Chicago who limited his work exclusively to surgery.

He was the first to use Listerism or antisepsis in Chicago. These were the pioneer days of modern surgery. Asepsis had not been thought of. The efforts to prevent surgical sepsis were, of course, faulty and often ineffective, but the fighting investigators struggled on and on toward the truth, and Edmund Andrews struggled as patiently and valiantly as any.

When one does the work of his day so conspicuously well that his brethren of the profession accept him as teacher and guide, the historian can do no less than make respectful obeisance and pass on.

As a teacher of surgery Dr. Andrews was always profoundly respected, yes, and loved, by his students. He was not a fluent speaker—he made no attempt

whatever at grace or elegance of diction,—but his utterances were unfailingly delivered with earnestness and power, and he was a great explainer and entertainer. He was there to teach and he taught well.

He carried no levity into the lecture room, though his bearing was always amiable and kindly and patient, and his words were often supplemented by offhand drawings on the blackboard. He was delightfully deft with the crayon and his illustrations, made with apparent casualness of stroke and without interfering with the consecutiveness of his speech in the smallest detail, contributed entertainingly to the clarity of his expositions. His mouth was as clean as a little girl's. A large heavy bustling personality,—a delightful laughter, a laughter which was not merely vocal and facial but included the shaking participation of his whole body and was full of happiness and mirth and reality. You had to laugh with him whether you saw the joke or not.

But he did not spend much time that way. He was too busy.

In times of quietness he often presented the appearance of preoccupancy of mind, not vacuity but concentrated activity,—the expression of a man whose mind was busy with problems and full of them. He loved problems and lived with them.

In relation to his fellow men, his mind was remarkably free from unfriendliness. Hollister, who had known him intimately since their school-boy days, testifies that he had never heard an unfriendly or a caustic word from Dr. Andrews' lips concerning another member of the profession. He exemplified in his conversations the truth of the scriptural declaration that "Charity suffereth long and is kind." He could hardly fail to be a devout man born as he was into an atmosphere of religion and reared in it. But his religion was very unobtrusive. He merely lived it—that is all.

Dr. Edmund Andrews, scholar, thinker, investigator, who under the guise of honestly seeking information was usually giving more than he received. Modest in demeanor, he was generally regarded as the most learned—at least as one of the most learned,—members of his profession. He left some enduring proofs of his usefulness to the world:

The Museum of the University of Michigan,
The Michigan State Medical Society,
The Chicago Medical College,
Origination of Army Records in the Surgeon General's Office,
Original Studies and Records of Gas-Oxygen Anæsthesia,
The Chicago Academy of Science.

WILLIAM E. QUINE.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD MAY 19, 1922, DR. WILLIAM C. DANFORTH, PRESIDING

URETERO-ABDOMINAL FISTULA

DR. EMIL RIES: The patient, a woman, 37 years of age, was married in 1906. In 1908 she was operated on, at which time she says that two tubes, one ovary, and the appendix were removed. She was in fairly good health until 1920, when she began to have protracted and copious menstruations. She was operated on December 1, 1921, by another operator who found a great deal of difficulty in removing the large uterus because of adhesions. Three or 4 days after operation watery fluid came out of the abdominal incision which had been made close to the first—a median incision. This fluid soon gave evidence of being urine. From that time until I saw the patient she continued to discharge urine through the sinus in the abdominal incision. At the same time she urinated in good quantities through the natural channels. When she came to me on March 5, 1922, she was wearing a glass tube in the fistula which was connected with a rubber glove, the latter serving as a sort of urinal. The skin of the abdomen was dark and eroded, the result of being constantly wet with urine and partly on account of the adhesive plaster that held the glass tube. It took from March 5th to 13th to heal this condition so I could operate.

Examination of the patient showed a fistula with some granulation tissue. The urine from that opening was cloudy, while that from the bladder was clear. An instrument introduced into the bladder did not come in contact with an instrument introduced into the fistula and the one introduced in the bladder did not come out through the fistula. Cystoscopic examination showed the bladder normal except for considerable congestion in the trigone, and the right ureter admitted the ureteral catheter to 5 centimeters, the left to 13 centimeters. The left ureteral catheter showed a free flow of urine, while there was none from the right. The right ureter was dead.

On March 13 I made a right rectus incision and found adhesions so extensive that it was possible to leave the abdominal cavity closed and do the operation extraperitoneally. The cæcum and ascending colon were pushed toward the median line and dissected out posteriorly. It was easy to find the right ureter which was as thick as my little finger and full of fluid. I followed that up to the kidney. It was more difficult toward the bladder because the bladder was bound down by adhesions to the peritoneum and there was considerable scar tissue all along the bladder wall. However, I dissected the bladder free on the right side sufficiently so that I could push it up with a catheter introduced through the ureter. I hoped to get enough of the bladder wall movable to make an anastomosis possible. The ureter was dissected free down into the broad ligament where it disappeared into the scar tissue. At this point it was cut off and I attempted to draw that ureter into the bladder. I made an opening into the bladder over the catheter. I then put two linen thread guides into the ureter and passed them through the catheter and pulled out the catheter. Twice the linen guides in the ureter tore out because there was too much tension. The third time, after loosening up the bladder more and pushing it up toward the right side, I succeeded in getting the ureter into the bladder with a chance of its holding. The ureter was then attached to the bladder in the usual way with a few sutures. Guides were left in end of ureter and in urethra and fastened outside by usual means.

In three days, urine was again escaping through the fistula. The patient's temperature began to rise and there were symptoms of a urinary infiltration. Forty-eight hours after the first operation I opened the sutures and found the ureter without any difficulty because it was necessary only to push aside the cæcum. The ureter was apparently well fastened to the bladder but since it leaked it was evidently not fastened well enough. I cut the threads, sewed up the opening in the bladder, tied a knot in the ureter, and put a ligature over the knot. I tied only a single knot because there was not enough ureter to tie more. The ureter was as thick as my little finger and did not tie very well. However, I put a linen ligature below the knot. At the time of operation the urine was smoky. The patient continued to have temperature and in a few days began to pass urine through the wound. I opened it again and removed the kidney and ureter on the right side. It was very simple and took about 25 minutes. This kidney is an infected hydronephrosis. There had been a stricture in consequence of the fistulous formation. As is so frequently the case where there is stricture formation there was a hydro-ureter and hydronephrosis. The pelvis of the kidney is large and the ureter much thickened. After the nephrectomy the patient made a perfectly smooth recovery. I saw her about 10 days ago and she is perfectly well.

This case is interesting from more than one angle: First, as to the cause of the hole in the ureter. It was probably the result of some kind of trauma. I learned that the operator who previously had the case passed some artery forceps down into the pelvis and left them there for 24 hours because of the severe hæmorrhage. It is possible that one of those forceps caught the ureter and produced gangrene. Second, the fact that the fistula was not a ureterovaginal one, but a uretero-abdominal fistula extending some distance from the point at which the ureter was strictured to the abdominal wall. Third, as to the formation of the walls of such a large fistula extending from way down in the broad ligament to the abdominal wall. The bladder formed the anterior wall of the sinus and the ureter was cut near the point where it entered the bladder. My ureteral catheter entered for a distance of 5 centimeters. The abdominal cavity was protected by adhesions.

A problem which arises in such cases is whether, if there is a leak after an anastomosis, it is wiser to wait or to risk a second operation 48 hours after the first. I decided that I would rather operate again than expose the patient to urinary infiltration. I think the outcome justified my decision. Why the ureter did not hold I believe was due to the fact that it was too short.

There is nothing to be said about the kidney specimen except this, we are all trying conservative operations on such fistulous ureters, we are all trying to save kidneys, but where the kidney continues to discharge cloudy urine it is a question whether the ureter will ever return to normal. When a kidney is not perfectly normal a nephrectomy is a much more simple operation than is an attempt to save the kidney by working in the adhesions of two or three previous operations. This is especially true when it is impossible to determine how much anatomical change has been produced or how much damage has been done.

DISCUSSION

Dr. T. J. Watkins: In such cases I occasionally have been tempted to make a tongue-shaped flap of the bladder wall for an anastomosis for a short ureter, but have never done it.

Dr. Emil Ries (closing the discussion): Flap methods are often used in stomach surgery for the purpose of making a fistula. The Witzel fistula has been recommended for the bladder. In this particular case such a flap might have allowed of lengthening of the bladder, so that the bladder would have met the ureter more closely, but there was so much cicatricial change that I left that out of the question.

ANACATADIDYMUS TERAS

Dr. Louis Gambee: This specimen is the result of a first pregnancy in a woman, 27 years old, a case of Dr. Simon. There was nothing of interest in the history, nothing in the way of abnormality, and nothing in the clinical history. This fœtus is a double monster in which there is a union from the pubes to the urachus. Some of these monsters have two, three, or four legs. The four-legged variety, of which this is a specimen, is known as the anacatadidymus teras (?). In these cases there is usually some abnormality in the genitals—an atresia of one or both recta and ani or simply one anus.

DISCUSSION

Dr. Joseph L. Baer: This specimen is the third pair of united twins we have had at Michael Reese Hospital in 4 years. The first was full term, the second was about 6 months, and the third is the specimen that is being passed around.

ABDOMINAL TUMOR CONSISTING OF SMALL INTESTINE WITHIN PERITONEAL SAC

Dr. Joseph L. Baer: This patient, age 51, entered the hospital in the night because of acute pain in the right lower quadrant of the abdomen. Examination showed a mass about the size of a child's head which was globular in form and movable. There were some obstructive symptoms. At laparotomy the next day the mass was found to occupy the left lower quadrant and consisted of bowel. Because of inability on the operating table to determine whether it was malignant or obstructive a resection was done between clamps, the bowel removed being the terminal end of the ileum. The ends of the bowel were closed and turned in and a lateral anastomosis was done from the proximal end of the ileum to the head of the cæcum. Following that the circulation of the appendix seemed to be involved and because of discoloration an appendectomy was done. Recovery was uneventful without further obstructive symptoms. The tumor on being opened proved to be only a mass of small intestine enclosed within a peritoneal sac. The report of the pathologist was as follows:

"*Gross.* Convoluted mass of small intestine covered by thin smooth membrane of the appearance of mesentery. The mass as received is 22 centimeters long with folds and convolutions. By separating the adhesions this intestine is 64 centimeters long. The mucosa and submucosa along the muscle nodes are normal. The serosa is thickened and is infiltrated by eosinophiles and lymphocytes. Similar cells are also present in the outer muscular layer. There is nothing to suggest that the tumor is tuberculous or any other specific process."

It so happened that just at that time an article appeared in the *Archives of Surgery* by Dr. A. Murat Willis of Richmond, Virginia, in which he described a tumor of the bowel unique in his experience and unique so far as he could determine in the literature. The photographs that accompanied the article were exact duplicates of the appearance presented by our tumor in the abdomen and afterward on being split open. The consistency of the tumor before the mass was excised was rather doughy.

PERSISTENT CORPUS LUTEUM CYST CAUSE OF HYPERTROPHY OF LINING OF UTERUS

DR A. H. CURTIS: A woman of 36 who had three healthy children had been bleeding for a period of two or three years to such an extent that she was transfused at Minneapolis last fall. At one time her hæmoglobin went down to 20 per cent. There had been a previous operation at which time the right ovary was removed. She had a miscarriage in December and because of persisten bleeding we curetted, thinking there might be some retained decidual material. Dr. LeCount decided there was danger of a chorio-epithelioma and advised that we perform a hysterectomy to be certain that she have no future trouble. On opening the abdomen I found the remaining ovary, which contained a corpus luteum cyst. The fundus of the uterus when removed was full of very foul, bloody material and on microscopic examination we found an enormously hypertrophied endometrium. Instead of the usual glandular enlargement associated with ordinary bleeding or with the changes we find at the time of menstruation, we found that the glands had grown in a manner that simulated adenocarcinoma and that the endometrium was five or six times as thick as normal. The case is of interest chiefly because there was only one ovary which contained a persistent corpus luteum cyst. This suggests that persistent corpus luteum cysts are responsible for hypertrophy of the lining of the uterus.

Dr. Ries asked me a question about 4 years ago that I would like to answer now. It is in regard to the cyclic changes in the endometrium which were reported by Hitschmann and Adler. They believe that the endometrium follows a very well marked rule, that you can diagnose the resting stage, the premenstrual stage, and the menstrual state, and that which follows menstruation. He asked whether we have found great variation from this typical classification. This particular specimen which I spoke of, which has a cyst of the ovary associated with a very great development of the endometrium, with a cyst-like formation in the endometrium is typical of a very large number of instances which I have seen. I believe we have a great number of changes in the endometrium which are deviations from normal and which escape our attempts at classification.

DISCUSSION

DR. EMIL RIES: At the meeting of the American Medical Association in Atlantic City some 4 or 5 years ago I read a paper on alternating periodic ovarian tumors. These corpus luteum cysts have a great deal to do with irregular endometria. According to the paper we heard some time ago from Dr. Heaney on corpus luteum in animals, its influence on sterility is well recognized by veterinarians. I have seen ovarian cysts which give every symptom of extra-uterine pregnancies. The history is that menstruation has been delayed a week or two, then the patient starts to bleed. If operation is performed nothing but a corpus luteum cyst is found. On the other hand, patients come to the hospital because menstruation is delayed. A cyst on one side is found. You do not know whether it is a corpus luteum cyst or not but it breaks under your finger and the next day the patient menstruates. In such cases there is disturbed function of the endometrium.

DR. N. S. HEANEY: The persistent corpus luteum in animals is a solid body. The corpus luteum that Dr. Ries mentions as so often confused with ectopic pregnancy is a cystic body. About three weeks ago I operated upon the only case of a solid corpus luteum which I have thus far found in the human family. This patient came to me on account of hæmorrhages from a fibroid uterus and I found a solid body about an inch in diameter in the left ovary. I saw her 6 weeks later and the body was still there and in consequence I thought I was dealing with a fibroma of the ovary. Subsequently I did a vaginal hysterectomy. The body in the left ovary proved to be a solid corpus luteum. It was pedunculated and shelled out of its little pod exactly as does the persistent corpus luteum in cows.

DR. CURTIS: How did you know that it was a persistent corpus luteum?

DR. HEANEY: It was there at two examinations, 6 weeks apart.

PROLAPSE OF THE RECTUM

DR. THOMAS J. WATKINS: Miss E. W., age, 26; weight, 130; has always been well until recently except for minor illnesses. She had an extensive Whitehead operation in May, 1921, for large hæmorrhoids, complicated by some prolapse of the rectum. In September, 1921, she was referred to me for operation for rectal prolapse. Two or three inches of the rectum was prolapsed; no hæmorrhoids. The perineum was so much relaxed and stretched that it had the appearance of a perineum of pregnancy with the fœtal head presenting at the vaginal orifice. She was greatly disturbed when up and about and was obliged to remain in bed much of the time.

Operation. The operation consisted chiefly in repair of the levator ani muscle and its associated fascia. The posterior vaginal wall was incised from the cervix to the cutaneous surface down to the rectum. The peri-rectal fascia and levator ani muscle were sutured from the cervix downward to the skin surface, the sutures passing into the rectal wall so as to retract and fix it; a few linen sutures were used for the purpose of producing and stimulating an increased amount of scar tissue. The other sutures were catgut. After repair of the levator ani along the rectal plane, the muscle was exposed by incision along the pubic rami by lateral incisions and was repaired by the usual operation of perineorrhaphy. The prospects for a good result seemed excellent but she returned 1 month later with some rectal prolapse, but with a firm perineum. A small plastic operation on the rectal wall resulted in a cure.

The case was a congenital defective levator ani which became excessively relaxed, following the development of large hæmorrhoids.

Rectal prolapse is a hernia and results from a defective levator ani muscle. We believe that repair of the levator ani muscle along the rectal plane the entire length of the posterior vaginal wall, incorporating the rectal wall, is a valuable adjunct in the treatment of prolapse of the rectum.

DISCUSSION

Dr. Vernon C. David: The etiology of prolapse of the rectum is not entirely clear. Perhaps the most outstanding fact is its frequent occurrence in infancy and childhood. Napalhow's statistics show over 60 per cent of the cases were in children between 1 and 3 years of age. Waldeyers' postmortem study of the pelvis in a number of children who had a prolapse of the rectum brought out the fact that the anterior concavity of the sacrum was much diminished so that the ampulla of the rectum no longer settled into it on any increase of intra-abdominal pressure but was pushed downward. Zuckerhandl observed that the cul-de-sac of Douglas was deeper in embryonal life and early infancy, reaching to the lower border of the prostate in contradistinction to its usual position at the level of the seminal vesicles in adult life. In addition to these factors the marked relaxation of the levator ani, sphincters, and rectoperineal and rectococcygeal muscles in cases of rectal prolapse is well known. That any one of these factors is the deciding one in the causation of the conditions is doubtful. Jeannel and Verneuils have called attention to the rarity of rectal prolapse after traumatism or destruction of the sphincter ani muscles as, for example, after fistula *in ano* operation or in perineal lacerations. Lenormant destroyed the levator ani muscles in dogs and forcibly produced a prolapse of the rectum. This replaced itself and did not recur.

As to general factors it seems to me that prolapse of the rectum usually is seen in individuals suffering with tabes or other conditions where the general muscular tone is weak and atrophic. Long standing diarrhœa and factors causing increased intra-abdominal pressure play the principal rôle.

In the treatment of prolapse of the rectum the multiplicity of ways and means stamp the efficacy of the procedures with doubt. Many and varied operations and methods have been proposed. Of them all I regard as best the operation described independently by Rehn and Delorme about 20 years ago. This consists in a circular incision through the mucosa at the mucocutaneous line in the rectum, and a denudation of the entire prolapsing segment of its mucous membrane. The muscularis of the prolapsed bowel is now reefed longitudinally by catgut stitches which when tied collapse the prolapsed segment much like an accordion when it is closed together. This places the rectal muscularis inside of the sphincters, which are now narrowed by mattress stitches. Finally, after cutting off the excess mucosa it is sutured back to the skin. This operation is best done under local anæsthesia with addition of adrenalin to check some of the hæmorrhage. The principles underlying the operation are those of obliteration of the prolapse, plication of the sphincters and use of the puckered muscularis of the prolapse as a pessary, above the sphincters to prevent recurrence.

Dr. T. J. Watkins (closing the discussion): Dr. David described very clearly the etiology and treatment of rectal prolapse. If I had removed the mucous membrane and puckered the muscularis, as he described, in conjunction with the operation I did upon the levator ani, the second operation probably would not have been necessary. I approve highly of his remarks relative to the deep cul-de-sac of Douglas in such cases.

PELVIC MEASUREMENTS BY X-RAY

Dr. Alfred Baker Spalding, San Francisco, California, read a paper on "Pelvic Measurements by X-Ray" (see p. 813).

DISCUSSION

Dr. David A. Horner: There are some things about this method which make me rather doubtful of its value even though I was formerly enthusiastic about it.

Localization of points for all transverse measurements is easy in clear roentgenographs, but such very impor ant points as the promontory and the poste or surface of the pubis are very difficult to locate exactly even with the stereoscope.

If you ask a dozen people to identify the actual point called the promontory, the variations may be from 1 to 3 centimeters. Similar difficulties exist in localizing the desired point behind the pubis. These differences seriously affect the calculations. What is the conjugata vera? It is the available diameter between the promontory and that part of the symphysis which projects into the pelvic cavity. The pubic end of the conjugate is really cartilage and does not show on plates. Dr. Spalding points to the top of the symphysis, which to my mind is faulty. Anteroposterior views for sagittal measurements allow too many possibilities of error. Lateral pelvic views would be more accurate. Our fingers and the various internal pelvimeters are not always reliable.

Dr. Alfred Baker Spalding (closing the discussion): I would like to say that Dr. Thoms, of New Haven, has a method whereby he can very accurately measure the rim of the pelvis. I think the roentgenologists are helping us to secure accurate pelvic measurements, but I believe the obstetricians must co-operate with the roentgenologists, just as the surgeon co-operates with the roentgenologist. At Stanford we are working on a method of cephalometry that I believe is going to give accurate results.

AMERICAN COLLEGE OF SURGEONS

THE PRESIDENT'S ADDRESS, AMERICAN COLLEGE OF SURGEONS[1]

By JOHN B. DEAVER, M.D., F.A.C.S., PHILADELPHIA

WE have gathered here in this historic city at this time with the prospect of reaping goodly harvest of knowledge through the exchange of professional experiences and in the delights of pleasant social intercourse. Men have come from far and near to honor our meetings with their presence and by their presence to emphasize anew that science knows no boundaries, and that the American College of Surgeons, though national in name is international in scope.

Before slipping away into "well deserved obscurity," to use the words of your genial Director General, which he evidently thinks will be my lot after relinquishing the high office with which you have honored me, I want to express to the Director General himself, and to my associates in office, my deep appreciation of their cooperation and support in the performance of my presidential duties. That they have not weighed more heavily upon me than they have is entirely due to their kind consideration.

As the swift hands of time complete the circle of another twelve months in the annals of the American College of Surgeons, we find its activities increasing and its influence enjoying an ever-widening arena of usefulness. The reports of the various sections will give in detail the result of the work accomplished during the year. From a general survey of the work, we can gather the gratifying knowledge that our efforts have not been limited to the improvement of our immediate professional demands, but, that the College is carrying on the basic principles of the profession—for the good of humanity. The work of health propaganda has been extended over a larger number of communities than ever before. It has been my privilege to attend a number of the sectional meetings of the College held in various parts of the country. The fatigue of long journeys and the interruption to the regular routine of professional work have been more than compensated for by the hearty reception accorded me by my professional brethren and by the enthusiastic appreciation of the laity of our endeavors to put before them in simple terms some of the important aspects of things pertaining to public health and the prevention of disease. Without vain and pompous self-glorification, I believe that we here in America are pioneers in carrying directly to the people this vital message of improvement in the health of the race. We cannot help believing that the future is big with promise of the results of this phase of the activities of the College. The poet has said, Art is long and Time is fleeting, but he might well have included Science in his dictum. In the world of science and particularly in the realms of medicine and surgery, while alas, we sometimes too soon get the immediate results of our efforts, more often we have to wait in silence and in patience for the evidence of the beneficial results of our work. How often do we fondly think we have been successful when lo, we are confronted with disappointment. We have to wait at least five years before we can claim an actual cure for our cancer cases. All of us have seen a recrudescence of trouble in the region of the gall bladder after five, seven, and even ten years of apparent freedom from symptoms. In our experimental and research work, Science demands years of labor and patient waiting before the research worker dares to announce a triumphant result. No one better than we surgeons are aware of how limited we are in the midst of our tremendous forward strides in methods and technique. But whatever may be our shortcomings with regard to individual results, in the long run the work of the American College of Surgeons along the line of improved standards in surgery, in hospital management and in public health, must and will be productive of results, and today we may indeed harbor the assurance, that we are preparing a rich heritage for those who are to come after us.

It is in turn this consciousness that must inspire us to continue unabated our efforts along the lines so auspiciously inaugurated.

It was but natural that hospital standardization should develop as an important adjunct to the original purpose of the College—the betterment of surgery in this country. We cannot ex-

[1] Boston, October 23, 1922.

pect good surgery to emanate from poor surroundings. It is this part of our program also that is attracting the attention of the public at large. It is affecting the laity through the hospital Board of Trustees not all of whom, however, I am sorry to say, as yet realize the importance of scientific standards. Nevertheless, through the hospital boards to a great extent the message of improvement is being broad-cast. It is only natural that the more intelligent class of patients will always prefer the institution that conforms to the requirements of the College standards. It will not take long for other institutions to recognize this fact and to endeavor to work up to at least the minimum requirements which are necessary to be placed on the list of approved hospitals. In time, those institutions that cannot meet this test, let us hope will be eliminated.

But no matter how good the equipment or how perfect the organization, we cannot expect good surgery, except in the hands of good surgeons. Good surgery today means manual dexterity combined with critical acumen; quick decision combined with deliberate manipulation; keen observation combined with logical deduction; singleness of purpose combined with multiplicity of aims; and finally the enthusiasm of youth preserved undiminished throughout the years of work and worry.

These are the foundation stones upon which the American College of Surgeons is endeavoring to rear its super-structure. The international scope of our organization is attested by the presence of distinguished visitors from territories beyond the confines of these United States. That science recognizes no geographical boundaries likewise is attested by the national and international fame of him whom you have selected next to wear the mantle significant of the highest honor in the gift of the College. The president elect combines in his person the essentials of a good surgeon, and the sum and substance of our professional ideals, integrity coupled with originality, and the gift of imparting his vast knowledge to others.

The accomplished specialist, master in his chosen field, and at the same time the erudite scholar with that wide vision which only "an intimate acquaintance with the best that has been thought and said can confer." It is my privilege and very great pleasure to present to you your President-elect, Dr. Harvey Cushing.

ONTARIO SECTIONAL MEETING OF THE CLINICAL CONGRESS

THE Ontario Sectional Meeting of the American College of Surgeons was held in London, Ontario, on October 16 and 17.

The Hospital Conference was conducted in the auditorium of the Western University Medical School. The hall was packed beyond capacity with an audience representing hospitals in all parts of the Province of Ontario. Dr. George McNeill, chairman of the Executive Committee for the Province, presided. The program of this meeting was as follows:

Hospital Program of the American College of Surgeons .....Franklin H. Martin, M.D., Director General
Hospital Standardization:
Surgeon's Standpoint.....George W. Crile, M.D., Cleveland
Community Standpoint..D. A. Craig, M.D., Halifax
Standpoint of a Hospital Official.....George A. Ramsey, M.D, London
Hospital Superintendent's Standpoint.....R. Kingswood, M.D., Victoria Hospital, London
The Soul of Hospital Standardization.....Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association
Hospital Standardization and the Ontario Medical Association.....T. C. Routley, M.D., Secretary, Ontario Medical Association
Hospital Standardization in Canada.....Malcolm T. MacEachern, M.D.
Round Table discussion conducted by Malcolm T. MacEachern, M.D.

The Public Meeting was held in the Majestic Theater on Monday night. Long before the time for the program to begin, the theater was filled to the doors and some six or seven hundred people were unable to gain admission.

Address of Welcome.....Mayor J. C. Wilson, M.D., London, Ontario
The American College of Surgeons—Scientific Medicine and the Public.....Franklin H. Martin, C.M.G., M.D.
What Can Be Accomplished by Routine Prenatal Care .....John Osborn Polak, M.D., Brooklyn, N. Y.
The Ontario Medical Association and Hospital Standardization.....E. R. Secord, M.D., President, Ontario Medical Association
Hospital Standardization in Canada.....M. T. MacEachern, M.D., President, American Hospital Association
Experimental Medicine.....George W. Crile, M.D., Cleveland, Ohio
Better Hospitals.....Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association
Modern Public Health.....D. A. Craig, M.D., Halifax, Nova Scotia

Due to the energetic efforts of the local committee, this was one of the largest and most enthusiastic public meetings the College has ever held.

On Tuesday morning, clinics were conducted at the Victoria and St. Joseph's Hospitals.

A. Primrose, M.D., Victoria Hospital Operating Room .....Diseases of Breast
H. A. Bruce, M.D., Victoria Hospital Wards .....Diseases of Gastro-Intestinal Tract
Hadley Williams, M.D., Victoria Hospital Operating Room.....Prostate, Bladder, Nerve, and Bone Cases
E. Seaborn, M.D., and E. Hodgins, M.D., St. Joseph's Hospital .....Cystoscopic Clinic, Genito-Urinary Diagnosis
Septimus Thompson, M.D., Victoria Hospital Eye Operating Room.....Eye, Nose, and Throat Cases

The Scientific Meeting held at the Western University Medical School at 2:00 p.m. of the second day was crowded beyond capacity.

The Bad Risk Patient.....George W. Crile, M.D., Cleveland, Ohio
Dry Labor, Its Present Day Management by the General Practitioner (illustrated).....John Osborn Polak, M.D., Brooklyn, New York

A very excellent medical clinic was conducted by Dr. Leonard Rowntree, of Rochester, Minnesota, under the auspices of the Western Ontario Academy of Medicine.

At a meeting of the Fellows of the College it was decided to hold the next Ontario Sectional Meeting in Ottawa. The Ontario Executive Committee for the coming year is as follows:

Chairman: Dr. A. T. Shillington, Ottawa.
Secretary: Dr. George A. Ramsey, London.
Counsellor: Dr. L. F. Robertson, Stratford.

The new War Memorial Hospital for Children, attracted a great deal of attention. Lunches were provided by the ladies at the Memorial Hospital for those attending the meetings. The exhibits of work from the various hospitals in and about the city of London and the Queen Alexandra Sanatorium were very commendable and attracted much interest. The interest in this Sectional Meeting shown by the lay organizations, the churches, fraternal societies, and the press was exceedingly gratifying and contributed largely to the success of the meetings.

The Director General and Dr. MacEachern addressed the Rotary Club at their midday luncheon on Monday, October 16, and were given an enthusiastic hearing. Nowhere has there been greater enthusiasm in the movement for better health and better hospitals and in the American College of Surgeons than was found at the London meeting.